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DANA

Instruction Manual

980438

MIDGET II
SYSTEM #2

D-1A

MODEL 4700A DIGITAL MULTIMETER

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MODEL 4700A

DIGITAL MULTIMETER

DANA LABORATORIES, INC.
2401 CAMPUS DRIVE
IRVINE, CALIFORNIA 92664

DANA®

TELEPHONE (714) 833-1234
TELETYPE 910-595-1136
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February, 1973

Warranty

Within one year of purchase, Dana Laboratories will repair or replace your instrument, at our option, if in any way it is defective in material or workmanship. All parts and labor charges will be paid by Dana Laboratories. Just call Dana Product Service at (714)833-1234 collect in California, for assistance. We will advise the proper shipping address for your prepaid shipment. Your instrument will be returned to you freight prepaid.

DANA.

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SECTION 1

GENERAL DESCRIPTION

1.1 GENERAL.

1.2 The Dana Model 4700A Digital Multimeter (DMM) is a four-digit instrument providing measurement of DC volts, AC volts, and Kilohms with no external or plug-in accessories required. In addition, it is equipped with isolated BCD output and remote programming capability.

1.3 Five DC ranges provide resolution from 10 microvolts on the 0.1 volt range to 100 millivolts on the 1000 range. Four AC ranges, with bandwidth of 40 Hz to 100 KHz, provide resolution from 100 microvolts on the 1-volt range to 100 millivolts on the 1000 range. Six Kilohm ranges are provided with resolution of 10 milliohms on the lowest range (.1).

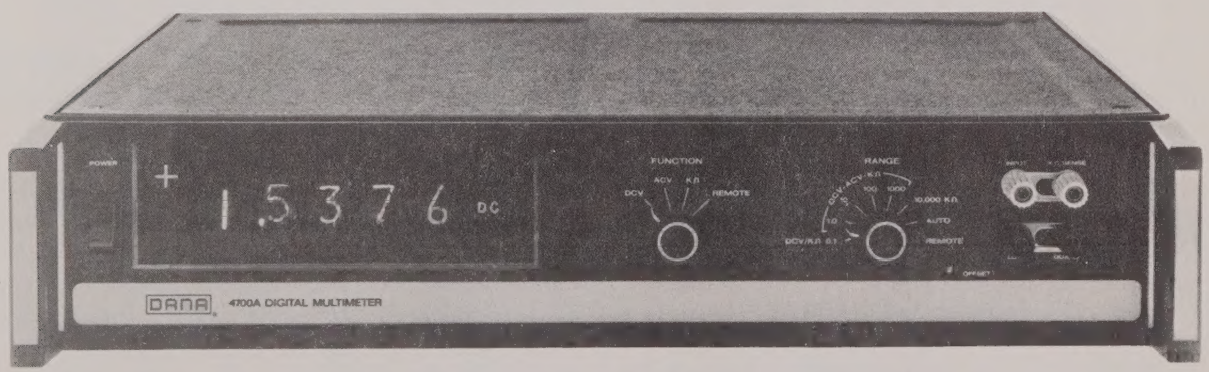
1.4 The instrument has complete autoranging capability in which internal circuits select the optimum range automatically. A fifth readout digit provides 100% overrange in all functions.

1.5 The BCD output and remote programming circuits are solid-state. Both range and function can be programmed remotely, overriding front-panel control settings.

1.6 ELECTRICAL DESCRIPTION.

1.7 DC voltages to be measured are converted to equivalent currents and applied to an integrator circuit that converts the input into an equivalent time period. The method used is called dual-slope integration.

1.8 AC voltages to be measured are first rectified to DC and converted into equivalent currents. For measurement of resistance, a precise current is generated within the instrument and applied to the unknown resistance. The resulting voltage drop across the DMM input is measured as a regular DC voltage.



Model 4700A Digital Multimeter

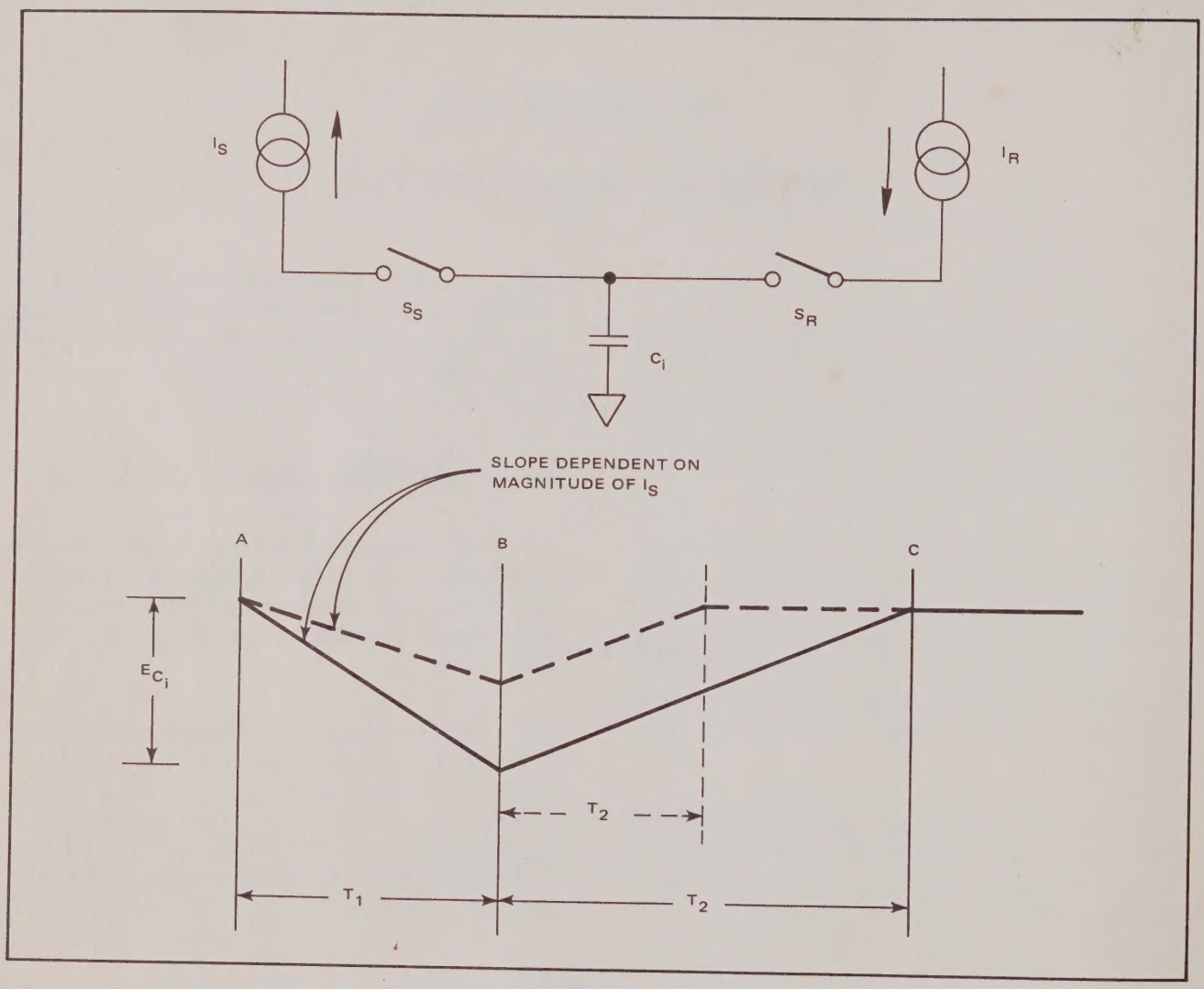


Figure 1.1 - Simplified Integrator Circuit

1.9 Figure 1.1 shows a simplified integrator circuit and the dual-slope produced. I_S and I_R, shown as current generators, represent current derived from the signal (I_S) and the reference current generated within the instrument (I_R). Both constant currents, they are applied to integrator capacitor C_i as the appropriate switch is closed.

1.10 Period T1 is the signal integration period. At time A, S_S closes and C_i (initially charged) begins to discharge. T1 is a fixed period. At time B, S_S opens and S_R closes starting the reference integration period (T2). C_i charges at a constant rate. The time required to charge the capacitor to zero is proportional to the voltage across the capacitor at the end of the signal integration period; therefore, it is proportional to the input.

1.11 A clock operates during the integration period. The clock pulses are counted by a counter and stored. The clock is stopped as the reference integration ramp reaches zero by a Zero Detect circuit. The contents of the counter is then displayed and routed to the BCD output circuitry.

1.12 SPECIFICATIONS.

1.13 Specifications are tabulated in table 1.1.

SECTION 5

CALIBRATION

5.1 EQUIPMENT REQUIRED.

a. Precision DC Voltage Standard (Fluke 332A or equivalent)

b. AC Lab Power Source (Optimation AC 104 or equivalent)

c. Microvoltmeter (Fluke 845 AR or equivalent)

d. Standard Resistor – 190 Kilohms

5.2 DC CALIBRATION (See figure 5.1).

1. Connect shorting bar across LOW and GUARD input terminals. Set FUNCTION switch to DC, RANGE to 0.1. Adjust OFFSET on front panel (R23) to the center of its mechanical span.
2. Short INPUT and LOW input terminals together with jumper. Connect a jumper across R8.
3. Connect microvoltmeter between the BSV terminal and mecca. Adjust R44 for a meter reading of less than ± 50 μvolts. Remove microvoltmeter leads. 42μv
4. Adjust R22 for the point where polarity signs change. Five digits offset is permissible at this point. Adjust OFFSET (R23) to obtain alternating + and – polarity signs on readout.
5. Set RANGE switch to 1.0. Apply –2.0000 millivolts to DMM input. Adjust R62 to obtain 0.0000 on readout.
6. Set RANGE to 0.1; short input terminals. Adjust R22 to obtain 0.0000 on readout with + polarity sign.
7. Set RANGE switch to 1.0. Apply +20.0 μvolts to DMM input.
8. Reverse polarity of input (to –20.0 μvolts). Verify that the polarity indication changes. A slight readjustment of OFFSET may be necessary.
9. Apply +80 μvolts to the input. Adjust R71 for alternating "0" and "1" in the least-significant digit and + polarity sign.
10. Apply –80 μvolts to the input. Adjust R62 for alternating "0" and "1" in the least-significant digit and – polarity sign.
11. Remove jumper from across R8; set RANGE to 1.0. Remove jumper from input terminals and replace with 1 megohm resistor. Adjust R14 for a readout of 0.0000 with + polarity sign. Remove 1 meg resistor.
12. Calibrate DC ranges in the following order. Adjust for readout values equal to input.

Range	Input	Adjust
1	+1.9000 VDC	R33
1	–1.9000 VDC	R60
10	+19.000 VDC	R2
10	–19.000 VDC 97	Check
100	+190.00 VDC	R4
100	–190.00 VDC	Check
1000	+1000.0 VDC	R6
1000	–1000.0 VDC	Check
.1*	+.19000 VDC	Check
.1	–.19000 VDC	Check

*Adjust OFFSET prior to checking .1 range (see para. 2.19.)

* DMM Should READ –0.0020

5.3 OHMS CALIBRATION.

1. Set FUNCTION switch to KΩ; RANGE to 100. Place jumper between the INPUT and Ω SENSE terminals and between LOW and GUARD terminals.
2. Connect a 190.00 kilohm resistor across the input.
3. Adjust R28 for 190.00 kilohm readout. Check accuracy of all ranges according to following table.

Range	Input	Tolerance
100 Ω	190 Ω	± 26 digits
1 KΩ	1.9 KΩ	± 9 digits
10 KΩ	19.0 KΩ	± 9 digits
100 KΩ	190.0 KΩ	± 9 digits
1000 KΩ	1.9 MΩ	± 96 digits
10000 KΩ	10.0 MΩ	± 96 digits

5.4 AC CALIBRATION.

1. Set FUNCTION switch to AC. Remove jumper from input terminals. Connect AC generator to input. Apply inputs as listed below and adjust the indicated control for a readout equal to the input voltage. The adjustments must be performed in the order listed.

Range	Input Voltage	Input Freq	Adjust	Tolerance
1	1.9000 VAC	400 Hz	R115	± 22 digits
1000	500.0 VAC	400 Hz	R96	± 8 digits
1000	500.0 VAC	10 KHz	C16*	± 28 digits
1	1.9000 VAC	10 KHz	C21	± 96 digits
10	19.000 VAC	400 Hz	R92	± 22 digits
10	19.000 VAC	10 KHz	C23	± 98 digits
100	190.00 VAC	400 Hz	R94	± 22 digits
100	190.00 VAC	10 KHz	C24	± 98 digits

***CAUTION**

High voltage is present at the 1000V adj. (C16). Use only an insulated calibration tool for adjustment of C16. Do not use a metal screwdriver.

Table 1.1 - Model 4700A Specifications

DC VOLTAGE

Full Range Display:	±.10000, ±1.0000, ±10.000, ±100.00, ±1000.0V
Overrange:	100% (except on 1000V range)
Maximum Input:	±1000V maximum input
Resolution:	10 microvolts
Accuracy: 1, 10, 100, and 1000V ranges 90 days, 25°C ± 5°C 0.1V range 90 days, 25°C ± 5°C	 ±(0.01% of reading + 0.01% of full scale) ±(0.02% of reading + 0.03% of full scale)
Polarity:	Automatic bi-polar
Input Resistance: 0.1, 1V ranges 10, 100, 1000V ranges	 1000 megohms minimum 10 megohms
Normal Mode Noise Rejection: At or near line frequency	 40 dB (100 to 1)
Common Mode Noise Rejection: At or near line frequency (100 ohms, either lead)	 100 dB (100,000 to 1)
Response Time:	500 mS

AC VOLTAGE

Full Range Display:	1.0000, 10.000, 100.00 and 1000.0V rms
Overrange:	100% (except on 1000V range)
Maximum Input:	500 volts rms or DC maximum input
Resolution:	100 microvolts rms

Table 1.1 - Model 4700A Specifications (Continued)

AC VOLTAGE (continued)

Accuracy:	
90 days, 25°C ± 5°C	
40 Hz to 5 kHz	±(0.1% of reading + 0.03% of full scale)
5 kHz to 50 kHz	±(0.5% of reading + 0.03% of full scale)
50 kHz to 100 kHz	±(1.0% of reading + 0.08% of full scale)
Input Resistance:	
1V range	2 megohms
all other ranges	1 megohm
Shunt Capacitance:	50 pF
Common Mode Noise Rejection:	
At or near line frequency (100 ohms, either lead)	100 dB (100,000 to 1)
Response Time:	3 seconds

RESISTANCE

Full Range Display:	.10000, 1.0000, 10.000, 100.00, 1000.0, 10000 kilohms
Overrange:	100%
Resolution:	10 milliohms
Accuracy:	
90 days, 25°C ± 5°C	
1, 10, 100 kilohm ranges	±(0.01% of reading + 0.01% of full scale)
0.1 kilohm range	±(0.06% of reading + 0.03% of full scale)
1000 kilohm range	±(0.20% of reading + 0.01% of full scale)
10,000 kilohm range	±(0.35% of reading + 0.01% of full scale)

Table 1.1 - Model 4700A Specifications (Continued)

RESISTANCE (continued)

Response Time:	
.1, 1, 10, and 100 kilohm ranges	500 mS
1000 kilohm range	4 seconds
10,000 kilohm range	10 seconds
Current Through Unknown:	
.1 kilohm range	1 milliampere
1 kilohm range	1 milliampere
10 kilohm range	100 microamperes
100 kilohm range	10 microamperes
1000 kilohm range	1 microampere
10,000 kilohm range	0.1 microampere
Fault Voltage:	
On any range	125V rms or DC

GENERAL

Ranging:	Automatic or Manual
Outputs:	TTL Compatible
True	+2.4V minimum
False	+0.4V maximum
Inputs:	TTL Compatible
True	+2.0V minimum
False	+0.8V maximum
Digitizing Time:	150 mS to full scale + 100%
Maximum Common Mode Voltage:	350V peak ac or dc
Maximum Power Requirement:	20 watts, ±10% line voltage, 45 to 70 Hz
Operating Temperature:	10° to 50°C

Table 1.1 - Model 4700A Specifications (Continued)

GENERAL (continued)

Warmup:	30 minutes to full accuracy
Dimensions:	3-1/2 x 16-3/4 x 15-5/8 inches (88.9 mm x 425 mm x 397 mm)
Weight:	14 pounds (approx.) net, 16 pounds (approx.) shipping
Guarantee:	12 months, faulty workmanship or component failure

SECTION 2

INSTALLATION & OPERATION

2.1 UNPACKING AND INSPECTION.

2.2 The Model 4700A DMM is secured in four molded, plastic-foam forms and packaged in a double-walled cardboard carton for shipment. The plastic forms hold the DMM securely in the carton and absorb any reasonable external shock normally encountered in transit. Prior to unpacking, examine the exterior of the shipping carton for any signs of damage. Carefully remove the DMM from the carton and inspect the exterior of the instrument for any signs of damage. If damage is found, notify the carrier immediately.

2.3 POWER CONNECTIONS.

2.4 A standard, eight-foot, three-wire power cable is supplied with the instrument. It connects to the POWER connector on the rear panel.

2.5 A .5 amp fuse is mounted on the rear panel of the instrument.

2.6 Instruments for export, designated as 4700A-E, are equipped with a special transformer and jumper matrix, allowing the user to adapt the instrument for operation on various line voltages. In figure 2.1 is shown the proper jumper placement on

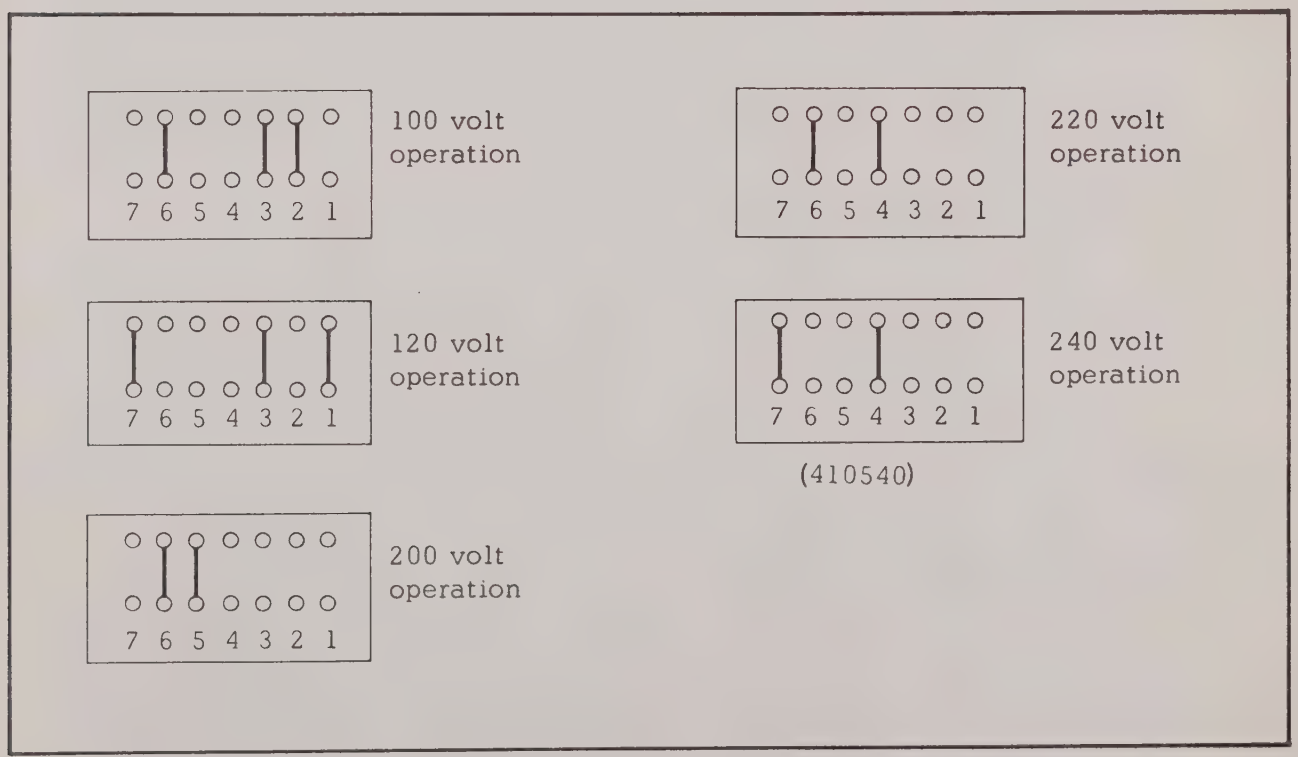

100 volt operation
7 6 5 4 3 2 1
220 volt operation
7 6 5 4 3 2 1
120 volt operation
7 6 5 4 3 2 1
240 volt operation
7 6 5 4 3 2 1
(410540)
200 volt operation
7 6 5 4 3 2 1

Figure 2.1 - Power Transformer Taps

the power matrix board for each line voltage. The matrix board assembly is mounted directly to the power transformer.

2.7 CONTROLS.

2.8 The POWER switch, on the front panel, applies power to the instrument when ON. The OFF position removes power from all portions of the instrument.

2.9 FUNCTION Select Switch. (See Table 2.1.)

Table 2.1 - Function Switch Positions

FUNCTION Switch Positions	Measurement Mode
DC	Selects the measurement of DC volts on the .1, 1, 10, 100, or 1000 range or Auto Range.
AC	Selects the measurement of AC volts on the 1, 10, 100, or 1000 range or Auto Range.
Kilohm	Selects the measurement of kilohms on any selectable range or Auto Range.
Remote	Enables the Mode selection to be made externally through the REMOTE PROGRAM connector or rear panel.

2.10 RANGE Select Switch. (See Table 2.2.)

Table 2.2 - Range Switch Positions

RANGE Switch Positions	Range
.1 thru 10000	Selects specific range. Ranges permissible for each Function are inscribed on panel.
AUTO	Enables the Range to be selected automatically by internal Auto Range circuitry that "upranges" at 19999 + 1 digit and "downranges" when the input is less than 01000.
REMOTE	Enables the Range selection to be made externally through the REMOTE PROGRAM connector on rear panel.

2.11 The OFFSET Adjustment is an operational adjustment used to "zero" the instrument readout. This control can also be adjusted to remove unwanted noise levels from the signal source (see paragraph 2.20).

2.12 INPUT CONNECTIONS.

2.13 Signal input binding posts are located on the front panel of the instrument. Connections to these terminals are made with standard "banana" plugs on the input cable. Instruments designated as 4700A-1 are equipped with a duplicate set of input terminals on the rear panel. The input may be connected to either set of terminals.

2.14 OPERATING INSTRUCTIONS.

2.15 A single-conductor shielded cable is required for interconnection between the AC or DC signal source and the DMM. The conductor carries the high side of the signal and connects to the INPUT

terminal. The shield connects to the LOW terminal (see figure 2.2).

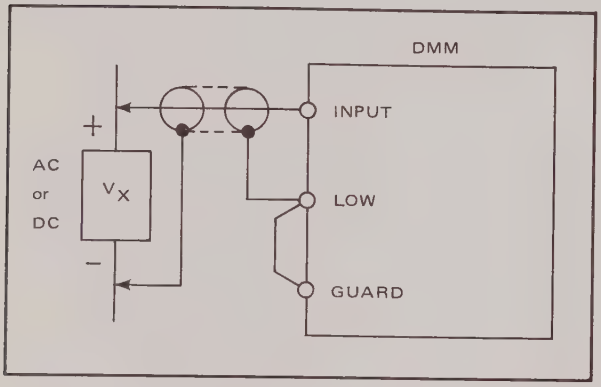


*Figure 2.2 - Basic Measurement Connection**

2.16 Where common-mode signals are present, a two-conductor shielded cable is required. Connections are made as shown in figure 2.3. The signal input terminals are isolated from the digital section and from power ground. The common-mode signal may be as high as 350V peak without damage to the DMM.

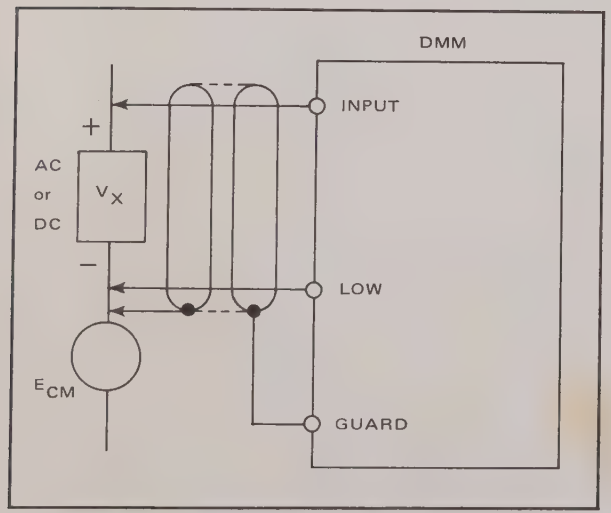


Figure 2.3 - Connections Where CM Present

2.17 For Kilohms measurement, connect leads to the unknown resistance as shown in figure 2.4.

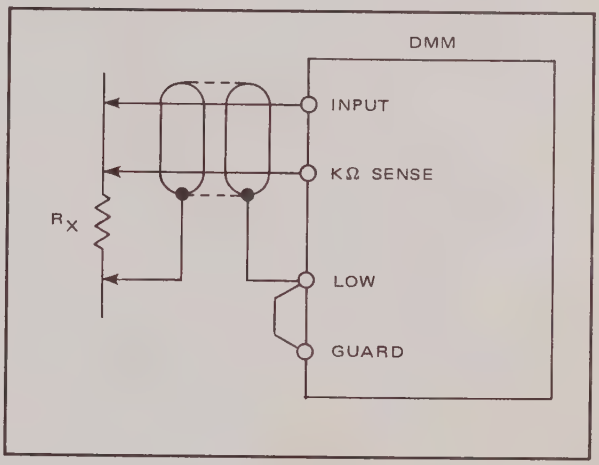


*Figure 2.4 - Connections for Kilohms Measurement **

2.18 Once the instrument has been connected to the power line and to the signal source in accordance with the instructions, the operator can make all required measurements by setting controls as described in tables 2.1 and 2.2.

CAUTION

Do not exceed the following maximum inputs:

DCV	1000 VDC or peak AC
ACV	500V RMS or 750 peak on any range
Kilohms	All Ranges: 115 VDC or RMS

*NOTE: For convenience in measuring ohms, the KΩ SENSE terminal and the INPUT terminal may be jumpered together. This may, however, cause noise to appear when measuring low-frequency, high (e.g. 300V) AC voltage.

2.19 OFFSET Adjustment.

2.20 Occasional adjustment of the OFFSET control (R23) on the front panel may be necessary. A small blade-type screwdriver is required.

a. Set FUNCTION switch to DCV.

b. Set RANGE to .1.

c. Short the INPUT and LOW terminals together.

d. Adjust OFFSET for all-zero readouts and polarity alternating "+" and "—".

SECTION 3

PROGRAMMING & BCD OUTPUT

3.1 PROGRAMMING/OUTPUT CONNECTOR.

3.2 Table 3.1 shows the pin assignments of J201 that includes both programming and output lines. The output is positive-true 8-4-2-1 BCD at standard TTL logic levels (0 to 0.4 volts False and 2.4 to +5.0 volts True). If pullup resistors are desired, they can be mounted on the main PC Board at the location indicated in figure 3.1. Resistors should be 1K, 1/4 Watt carbon.

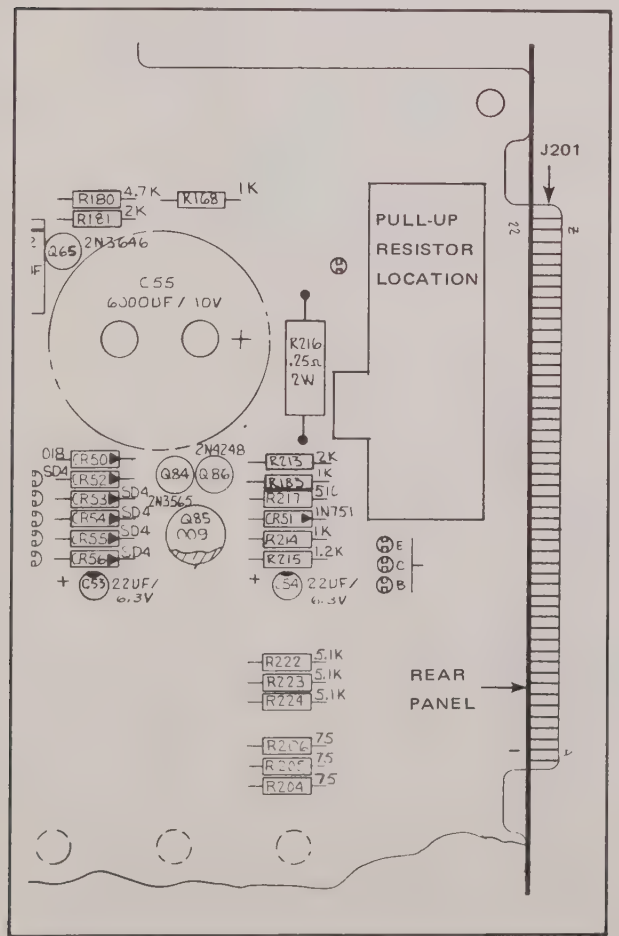


Figure 3.1 - Pull-up Resistor Locations

Table 3.1 - Remote Programming/BCD Output Connector J201

Pin	Input/Output Line	Pin	Input/Output Line
1	FC } Range	A	Decimal A
2	FB } Range	B	Decimal B
3	FA } Range	C	Decimal C
4	Remote Range	D	
5	Remote Function	E	
6	External Start	F	+5 Volts (1K source)
7	Hold A	H	Hold B
8	AC Volts } Function (Mode)	J	
9	Kilohms } Function (Mode)	K	
10	DC Volts } Function (Mode)	L	
11	Digital Common	M	
12	1 (8)	N	FS Out (Conv. Complete)
13	1 (4)	P	SDPC (Print)
14	1 (2)	R	1000 (4)
15	1 (1)	S	1000 (1)
16	10 (8)	T	1000 (2)
17	10 (4)	U	1000 (8)
18	10 (2)	V	100 (1)
19	10 (1)	W	100 (2)
20		X	100 (4)
21	+ Polarity	Y	100 (8)
22	OVR	Z	10000 (1)
(Top Contacts of Edge Connector)		(Lower Contacts)	
Mating Connector: Dana 600175 or Cinch 251-22-30-160			

3.3 FUNCTION PROGRAMMING.

3.4 For remote programming, Remote Function, pin 5, must be tied to Digital Common, pin 11, to disable the local FUNCTION switch. The function is then programmed by applying common to either of the function select pins (figure 3.2).

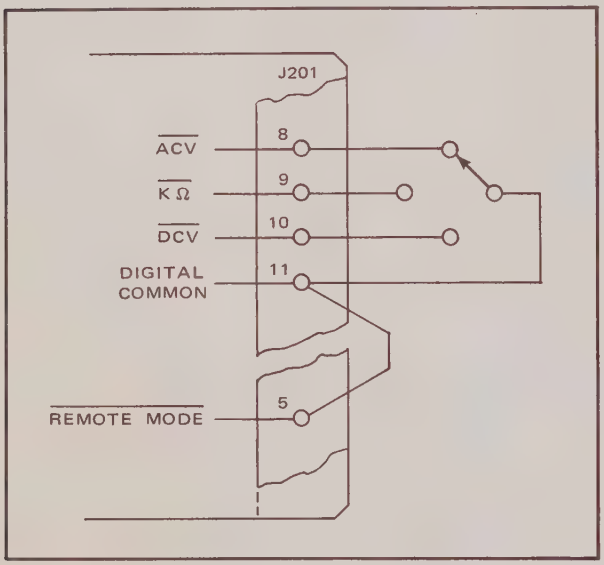


Figure 3.2 - Function Select Connections

3.5 RANGE PROGRAMMING.

3.6 Remote Range, pin 4, must be tied to Digital Common to disable the local RANGE switch. For Auto Range, pin 4 (only) must be connected to common. Specific ranges are commanded by FC, FB, and FA (pins 1, 2, and 3, respectively) according to table 3.2.

3.7 HOLD/EXTERNAL START COMMANDS.

3.8 EXTERNAL START is commanded by a negative-going pulse between pin 6 and common. This command is effective only if the Hold lines, pins 7 and H, are tied together. With the Hold lines connected to common, the instrument is in a "periodic" mode in which a new reading is automatically taken 3 to 4 times a second. A typical connection for External Start operation is shown in figure 3.3. EXT START requires a 4.5 volt swing. Pads are available on the motherboard for installation of a pull-up resistor, if desired.

Table 3.2 - Range Programming

Range	FA Pin 3	FB Pin 2	FC Pin 1
.1	0	0	0
1	1	0	0
10	0	1	0
100	1	1	0
1000	0	0	1
10000	1	0	1

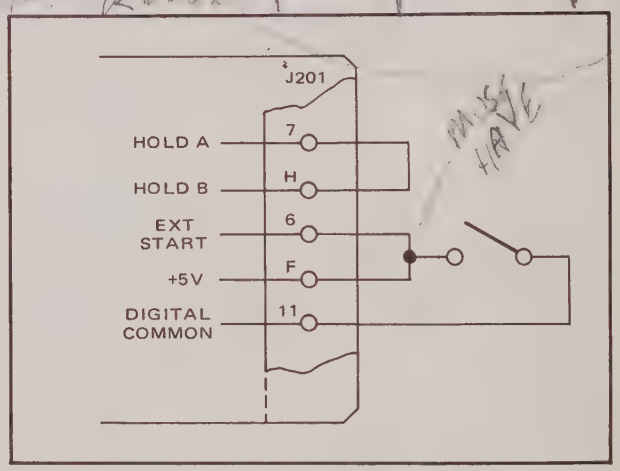


Figure 3.3 - External Command Operation

3.9 OUTPUT LINES.

3.10 Data Output lines are on pins 12 through 19 and R through Z. Table 3.1 denotes each line by decade and BCD weight. Pins A, B, and C indicate the range according to table 3.3.

3.11 FS (pin N) indicates that the signal integration period is complete. The system can then prepare for the next measurement (see figure 3.4). The next External Start command will be accepted after the Print command (System Digital Print Command, SDPC) on pin P.

Table 3.3 - Range Information

Range	Pin A	Pin B	Pin C
.1	0	0	0
1	1	0	0
10	0	1	0
100	1	1	0
1000	0	0	1
10000	1	0	1

3.12 If an overrange condition exists, SDPC is not generated (figure 3.4) and OVR (pin 22) is true. Pin 21, "+" Polarity, indicates positive input when True and negative input when False.

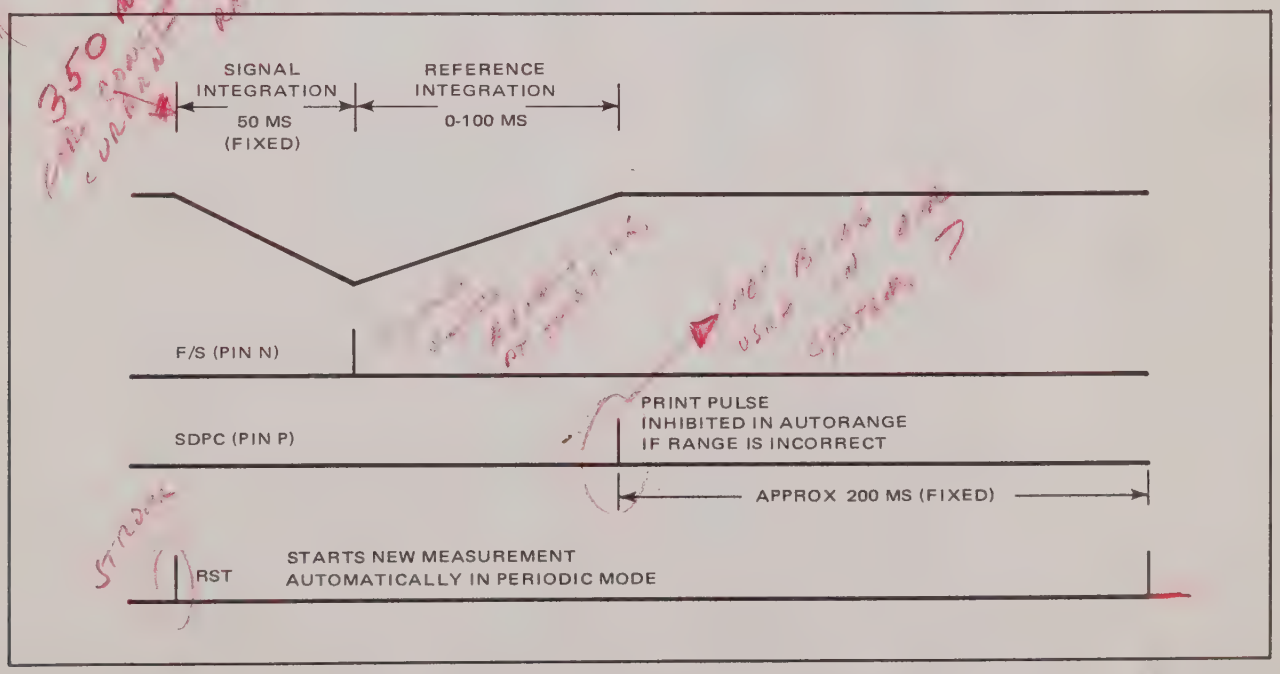


Figure 3.4 - Print Pulse Timing

SECTION 4

THEORY OF OPERATION

4.1 GENERAL.

4.2 Circuit descriptions in this section refer to both figure 4.1, simplified block diagram, and to schematic 430900 (3 sheets) in Section 6.

4.3 SIGNAL CONDITIONING.

4.4 DCV. A DC input is applied to the DC/Ohms range divider. The input is scaled down as follows: 1000V range: 1000 to 1; 100V range: 100 to 1; 10V range: 10 to 1; 1V range: 1 to 1, and the .1 volt range: 1 to 1. In the .1V range, the G_m Converter has a gain of ten. Otherwise, G_m Converter gain is one.

4.5 ACV. An AC input is applied to the input terminals and routed to the AC attenuator where it is scaled down by a factor of .5 in the 1V range, .05 in the 10V range, .005 in the 100V range, and .0005 in the 1000V range. The scaled AC signal is applied to the AC Converter (figure 4.2) where it is amplified by a potentiometric amplifier. The amplified signal is coupled through a capacitor to two diodes providing polarity-dependent feed-back paths. Each diode conducts during one-half of the AC signal. The bisected signal is summed across R114, R115 and fed back through capacitor C29 to the reference input of the amplifier. The closed loop gain of the amplifier is approximately 1.8. The positive half cycle developed across R113, R114, R115 is filtered by a resistor and a capacitor to produce a positive DC equivalent of the AC input signal. This signal is routed on to the G_m Converter.

4.6 OHMS. The Ohms Current Generator produces two voltages: Bootstrap Voltage +1 volt (BSV +1) and Bootstrap Voltage +10 volts (BSV +10). In all Kilohms ranges except the 10,000 range, a precise current generated from BSV +10 is applied through the series range resistance and INPUT terminal to the unknown resistance. The resulting voltage drop is measured and displayed directly as kilohms. In the 10,000 range, the current is derived from BSV +1. On the .1 range, the gain of the G_m Converter is increased from one to ten. The voltage drop to be measured is applied between the KΩ SENSE and LOW input terminals.

4.7 G_m CONVERTER.

4.8 The DC input signal passes from the attenuator through a single-pole filter composed of R8 and C_1 through C_4. The input filter helps to reduce the Normal mode noise on the input line. The signal is applied to M1 of the G_m Converter. The G_m Converter output is a current whose value is a function of the absolute value of the input signal and independent of the polarity. When the input signal is negative in polarity, the current from the G_m Converter flows into the Current Inverter (M6). The Current Inverter is a unity gain operational amplifier that inverts the flow of current at the output. The output of the G_m Converter and the output of the Current Inverter are connected together at TP1 to form the Signal Integrate current.

4.9 INTEGRATOR.

4.10 The integration period begins with the generation of Reset/Start (RST). RST is generated either by an External Start at the program input connector or after a 200 msecond delay when operating in "periodic" mode. Periodic mode exists when Hold lines A and B are tied to common (see paragraph 3.8). In this mode, a new measurement is taken automatically after the 200 msecond delay.

4.11 The Input flip-flop (Q30, Q31) is set by the trailing edge of the Reset/Start pulse. The output of the Input flip-flop closes the Signal Integrate switch (Q22) causing the Integrator capacitor to discharge through the output of the G_m Converter.

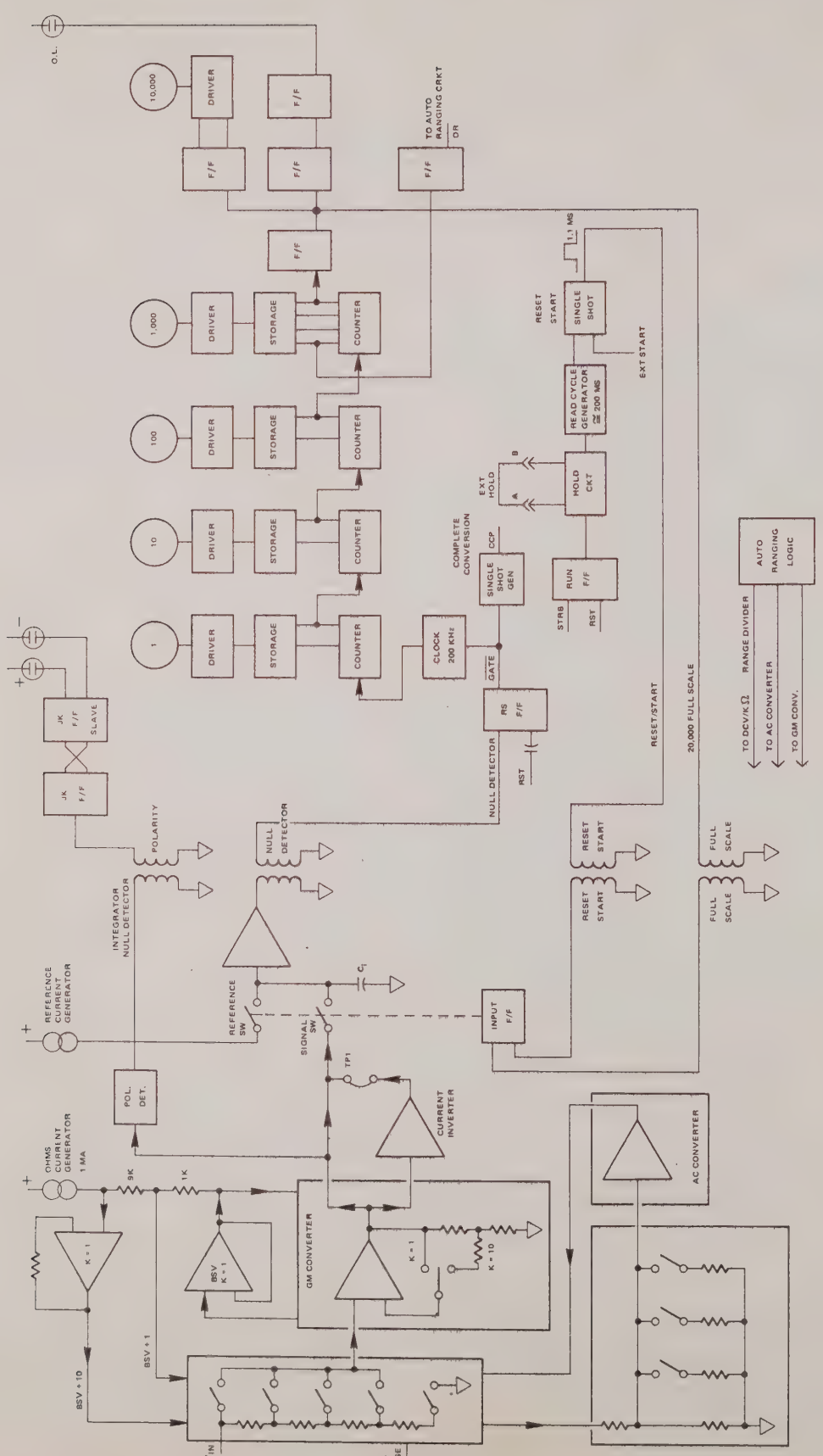


Figure 4.1 - Simplified Block Diagram

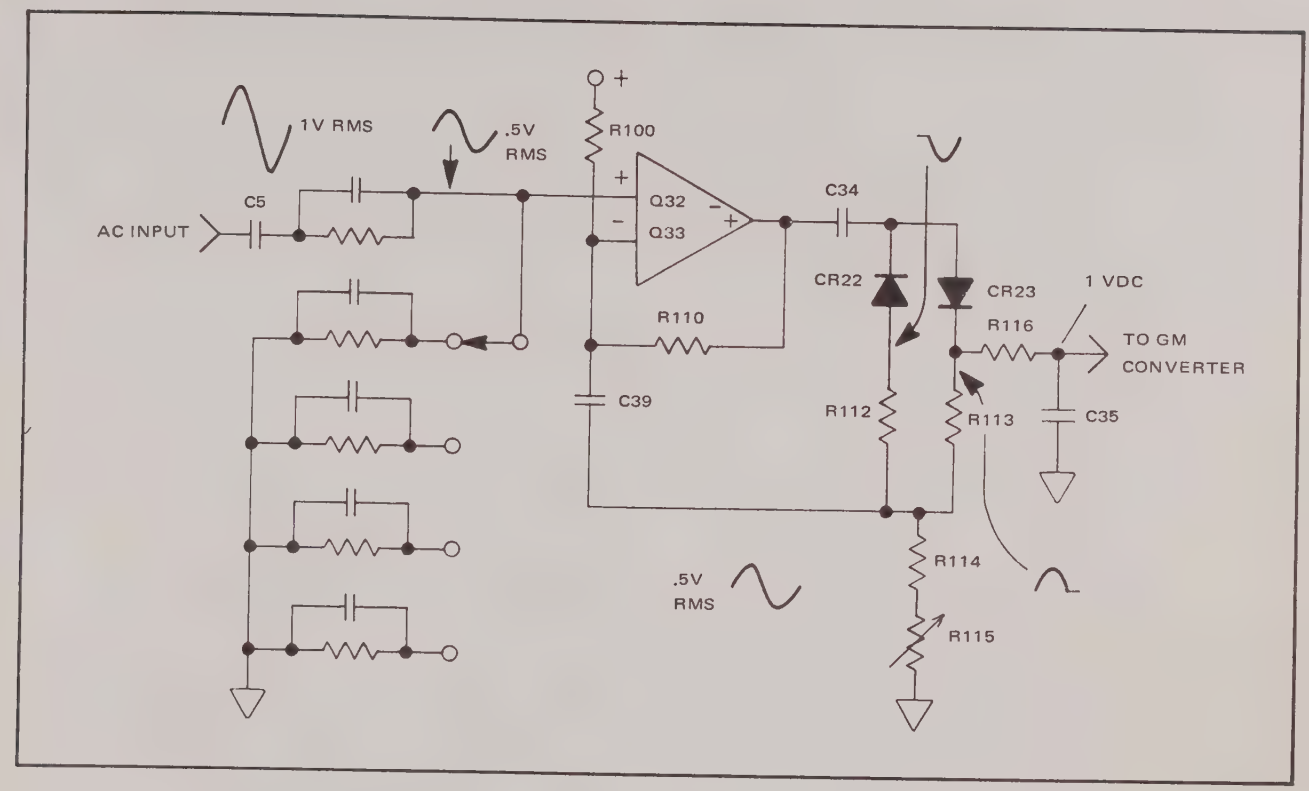


Figure 4.2 - Simplified AC Converter

The capacitor discharges at a constant rate dependent on the magnitude of the signal current during a fixed time period called Signal Integrate time. The Signal Integrate time is 10,000 clock periods or approximately 50 ms (figure 4.3). The counter is set to 10,000 at the beginning of the signal integrate time. The counter counts the clock periods and stops at 20,000 which is the equivalent to 00000. All zeros are displayed at this time if the input signal is zero.

4.12 At the time the Input flip-flop is set, an additional current drain is connected to the integrator capacitor. The current drain is adjustable (R71) to match the time the clock is held off during the reference period. This circuit is used to prevent noise or switching transients from causing a false null detection when the input signal is close to zero.

4.13 At the end of the Signal Integrate period, the clock is stopped while the Signal Integrate switch opens and the Reference Integrate switch closes. The reference current generator (M5) is connected to the integrator capacitor and charges at a constant rate. The time the integrator capacitor charges depends on the input signal which has removed a charge from the integrator capacitor during Signal Integrate time.

4.14 NULL DETECTOR.

4.15 The Null Detector generates a pulse when the voltage on the integrator capacitor reaches a null point. The pulse is coupled through a pulse transformer to the clock gate which goes true and stops the clock. The Conversion Complete single-shot multivibrator generates a pulse (CCP) which causes strobe pulse STBP (Nand gate M36-8) to go

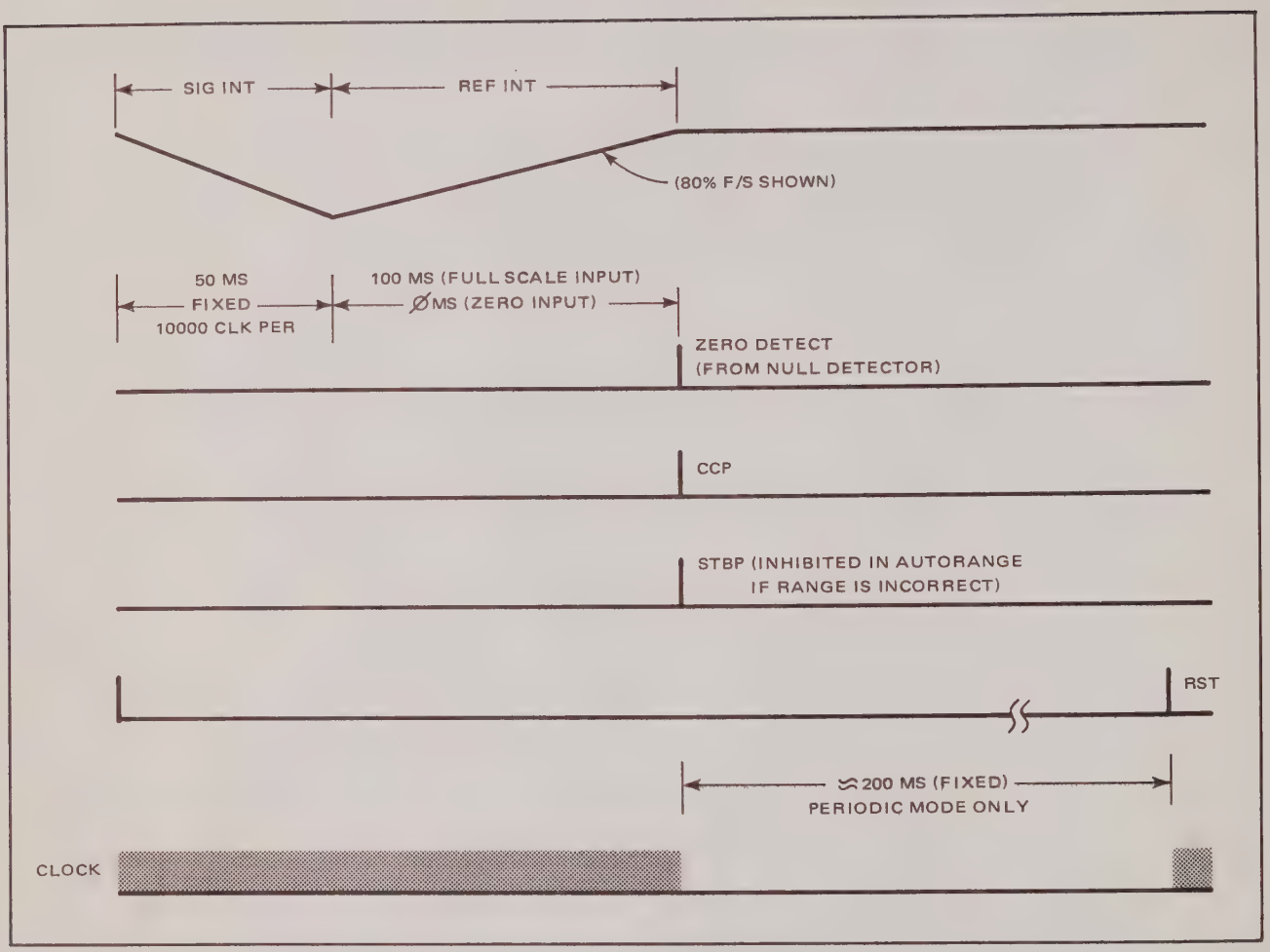


Figure 4.3 - Basic Timing

false. $\overline{\text{STBP}}$ strobes the counter information to the drivers and to the nixies for a readout display. $\overline{\text{STBP}}$ is inhibited in Autorange if range is incorrect.

4.16 POLARITY CIRCUITS.

4.17 Polarity is sensed at the output of the G_m Converter. During the Signal Integrate time, the base of Q17 is positive. At the end of signal integrate, the input F/F goes false allowing the base of Q17 to assume the same potential as the output of the G_m Converter. If the G_m Converter output is positive, no change takes place in Q17 or Q18. If the G_m Converter output is negative, Q17 stops conducting causing a pulse to be generated from L1. The pulse is coupled to the J-K flip-flop (M-23) which has previously been reset at the beginning of the read cycle. The flip-flop is set only when the input signal is negative. When $\overline{\text{STBP}}$ occurs, the information in the input gates of the "slave" polarity flip-flop is transferred to the polarity indicators.

4.18 RANGE CIRCUITS.

4.19 Range is determined by the state of the three range flip-flops (M44A, M44B, and M29). The three flip-flops form an Up/Down counter. Their outputs (A, B, C, and their complements) are applied to range logic gates (M37, M41, and M42) that decode the range signals and activate lines to energize the appropriate range relays.

4.20 Autorange logic at the input of the range counter receives signals indicating the state of the main counter at the time a Zero Detect pulse is generated by the Null Detector. If the counter is at less than 01000 digits, a Down range signal is generated. If the counter is at 19999 or greater, an Up range signal is generated. These signals, along with overrange (OVR) and function signals to inhibit "forbidden" range-function combinations, automatically cause the range counters to count up or down to the optimum range.

4.21 For manual range selection, the flip-flops comprising the range counter are forced to the desired state by the RANGE switch. Manual selection of forbidden ranges can be made by RANGE switch operation. This condition is indicated by more than one decimal point or function indicator lighting.

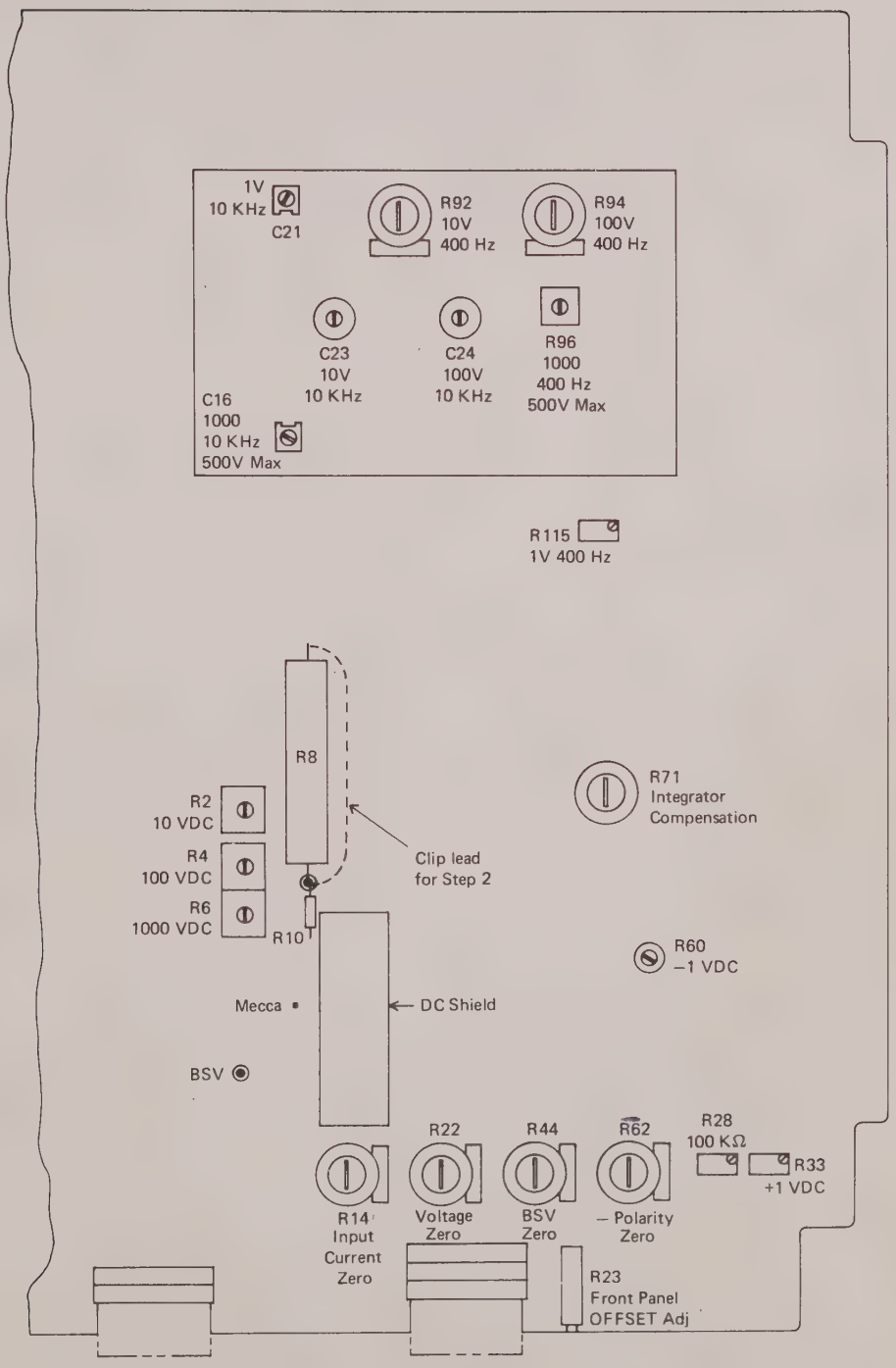


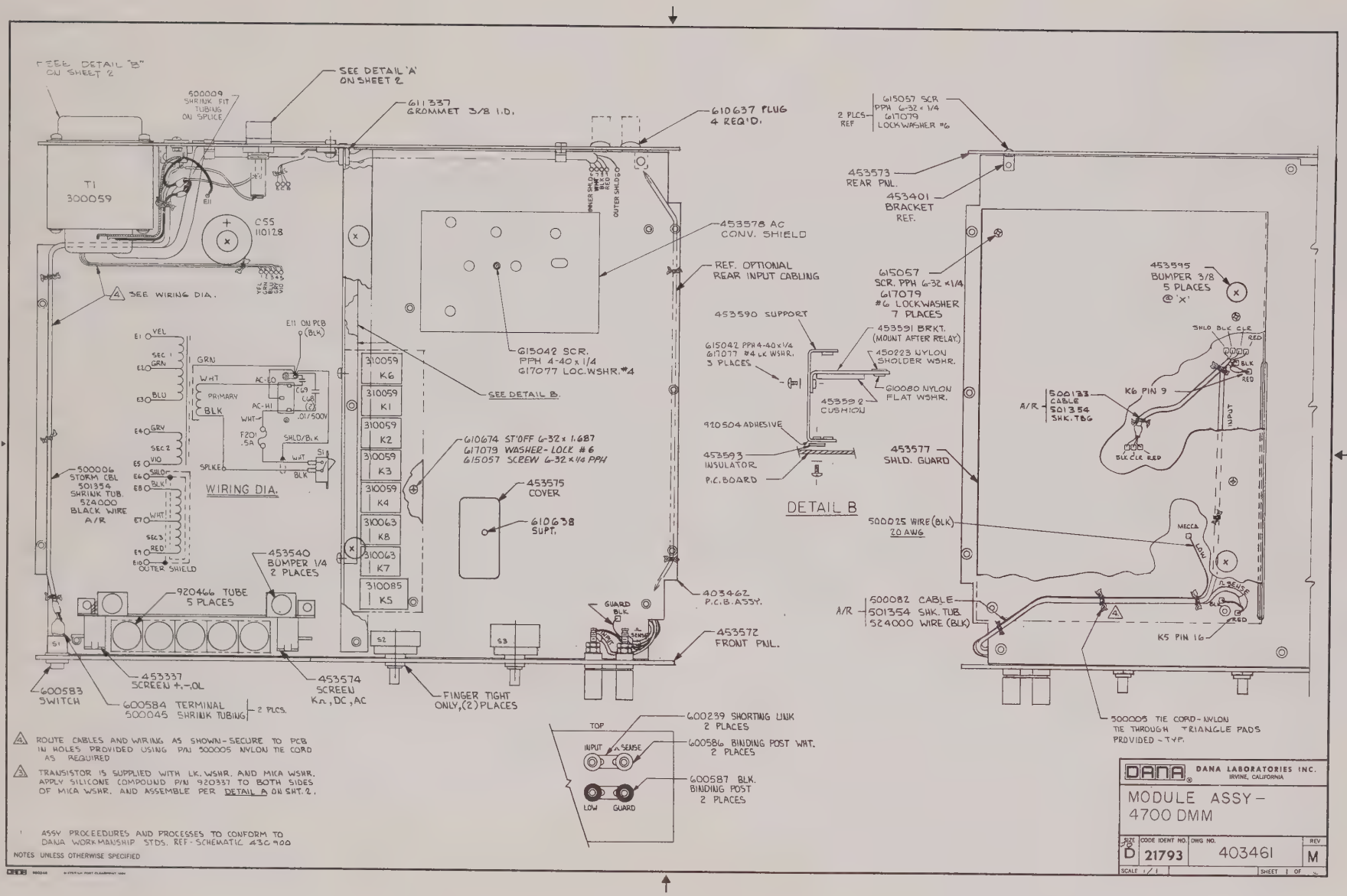
Figure 5.1 - Adjustment Locations

SECTION 6

DRAWINGS

6.1 DRAWINGS.

Module Assembly	403461 (2 sheets)
PCB Assembly	403462 (2 sheets)
Schematic	430900 (3 sheets)


SEE DETAIL 'B' ON SHEET 2
SEE DETAIL 'A' ON SHEET 2
500009 SHRINK FIT TUBING ON SPLICE
611337 GROMMET 3/8 I.D.
610637 PLUG 4 REQ'D.
T1 300059
CSS 110128
SEE WIRING DIA.
453578 AC CONV. SHIELD
REF. OPTIONAL REAR INPUT CABLING
615042 SCR. PPH 4-40 x 1/4 617077 LOC.WSHR.#4
SEE DETAIL B.
310059 K6
310059 K1
310059 K2
310059 K3
310059 K4
310063 K8
310063 K7
310085 K5
610674 ST'OFF 6-32 x 1.687 617079 WASHER-LOCK #6 615057 SCREW 6-32 x 1/4 PPH
453575 COVER
610638 SUPT.
WIRING DIA.
E11 ON PCB
500006 STORM CBL 501354 SHRINK TUB. 524000 BLACK WIRE A/R
453540 BUMPER 1/4 2 PLACES
920466 TUBE 5 PLACES
403462 P.C.B. ASSY.
453572 FRONT PNL.
453337 SCREEN +,-,OL
453574 SCREEN K Ω, DC, AC
600583 SWITCH
600584 TERMINAL 500045 SHRINK TUBING 2 PLCS.
FINGER TIGHT ONLY, (2) PLACES
TOP
600239 SHORTING LINK 2 PLACES
600586 BINDING POST WHT. 2 PLACES
600587 BLK. BINDING POST 2 PLACES
INPUT
SENSE
LOW
GUARD
2 PLCS REF
615057 SCR PPH 6-32 x 1/4 617079 LOCKWASHER #6
453573 REAR PNL.
453401 BRACKET REF.
615057 SCR. PPH 6-32 x 1/4 617079 #6 LOCKWASHER 7 PLACES
453590 SUPPORT
615042 PPH 4-40 x 1/4 617077 #4 LK WSHR. 3 PLACES
453591 BRKT. (MOUNT AFTER RELAY)
450223 NYLON SHOLDER WSHR.
610080 NYLON FLAT WSHR.
453592 CUSHION
920504 ADHESIVE
453593 INSULATOR P.C. BOARD
DETAIL B
453577 SHLD. GUARD
500025 WIRE (BLK) 20 AWG
453595 BUMPER 3/8 5 PLACES @ 'X'
A/R 500133 CABLE 501354 SHK. TBG
K6 PIN 9
500082 CABLE A/R 501354 SHK. TUB. 524000 WIRE (BLK)
K5 PIN 16
500005 TIE CORD-NYLON TIE THROUGH TRIANGLE PADS PROVIDED - TYP.

4 ROUTE CABLES AND WIRING AS SHOWN - SECURE TO PCB IN HOLES PROVIDED USING P/N 500005 NYLON TIE CORD AS REQUIRED

3 TRANSISTOR IS SUPPLIED WITH LK. WSHR. AND MICA WSHR. APPLY SILICONE COMPOUND P/N 920337 TO BOTH SIDES OF MICA WSHR. AND ASSEMBLE PER DETAIL A ON SHT. 2.

1 ASSY PROCEEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STDS. REF - SCHEMATIC 432900

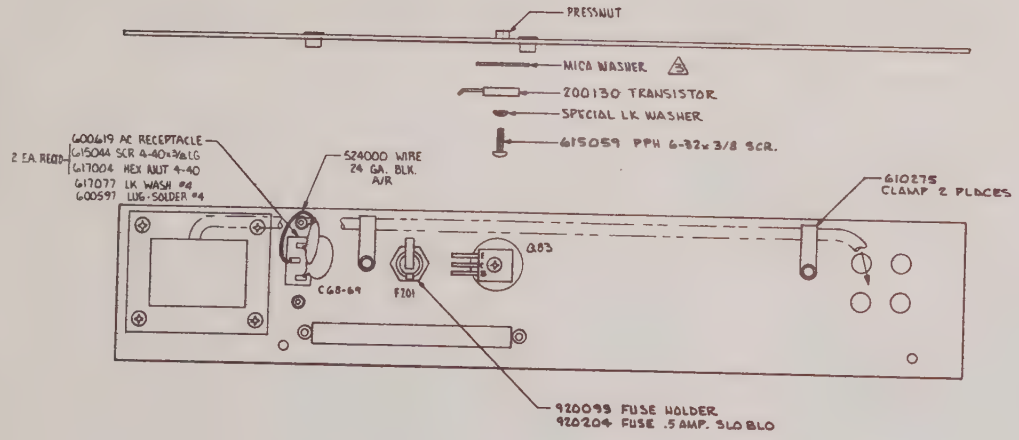
NOTES UNLESS OTHERWISE SPECIFIED

DANA LABORATORIES INC. IRVINE, CALIFORNIA

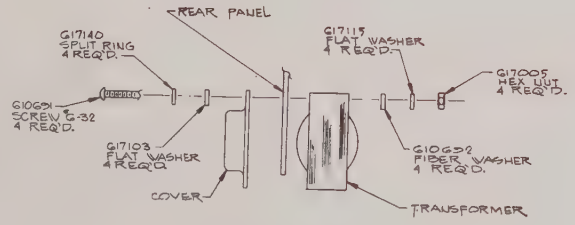
MODULE ASSY - 4700 DMM

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	403461	M

SCALE 1/1 SHEET 1 OF



DETAIL A



DETAIL "B"

△ SEE SHT 1

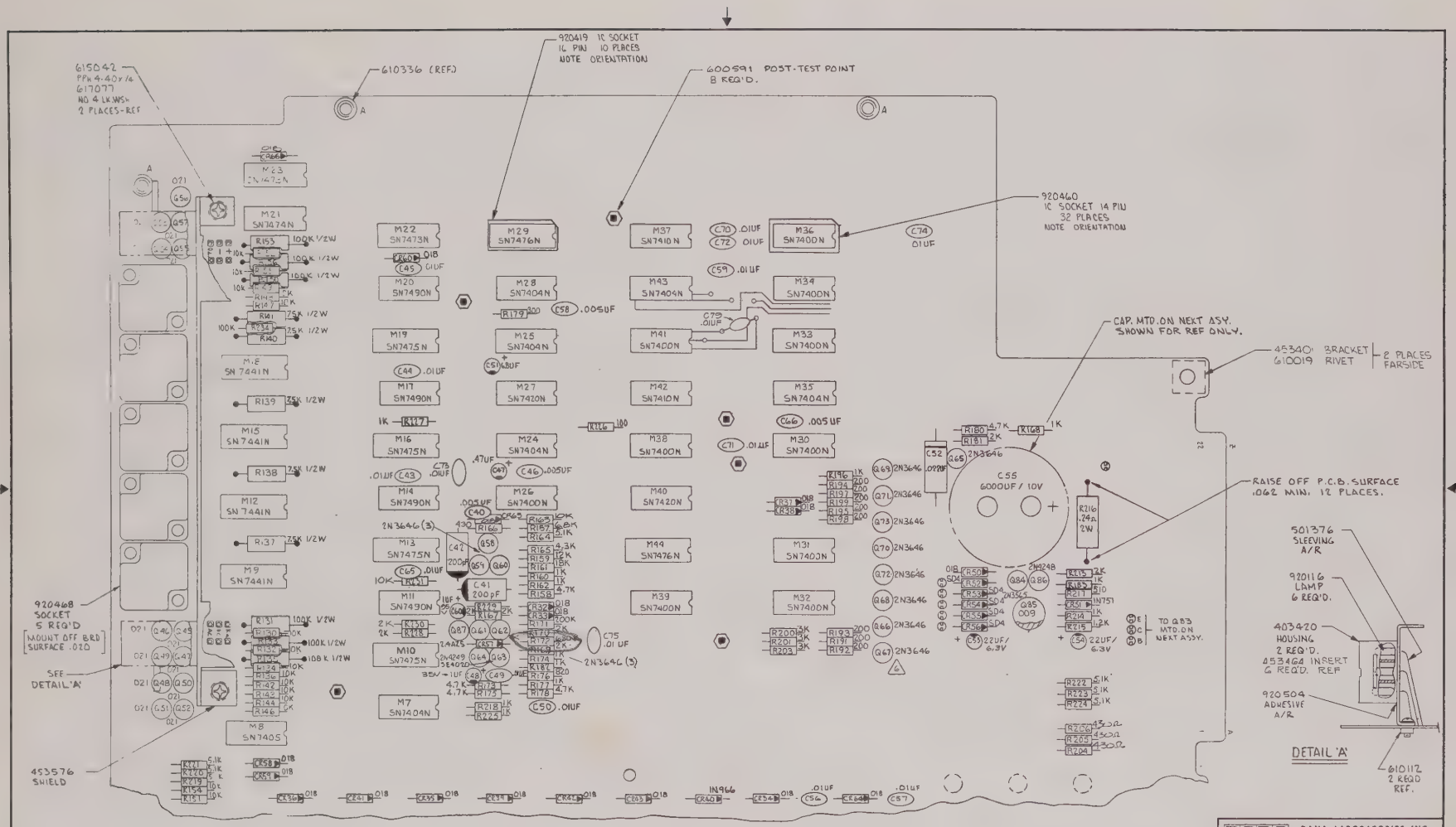
NOTES: UNLESS OTHERWISE SPECIFIED

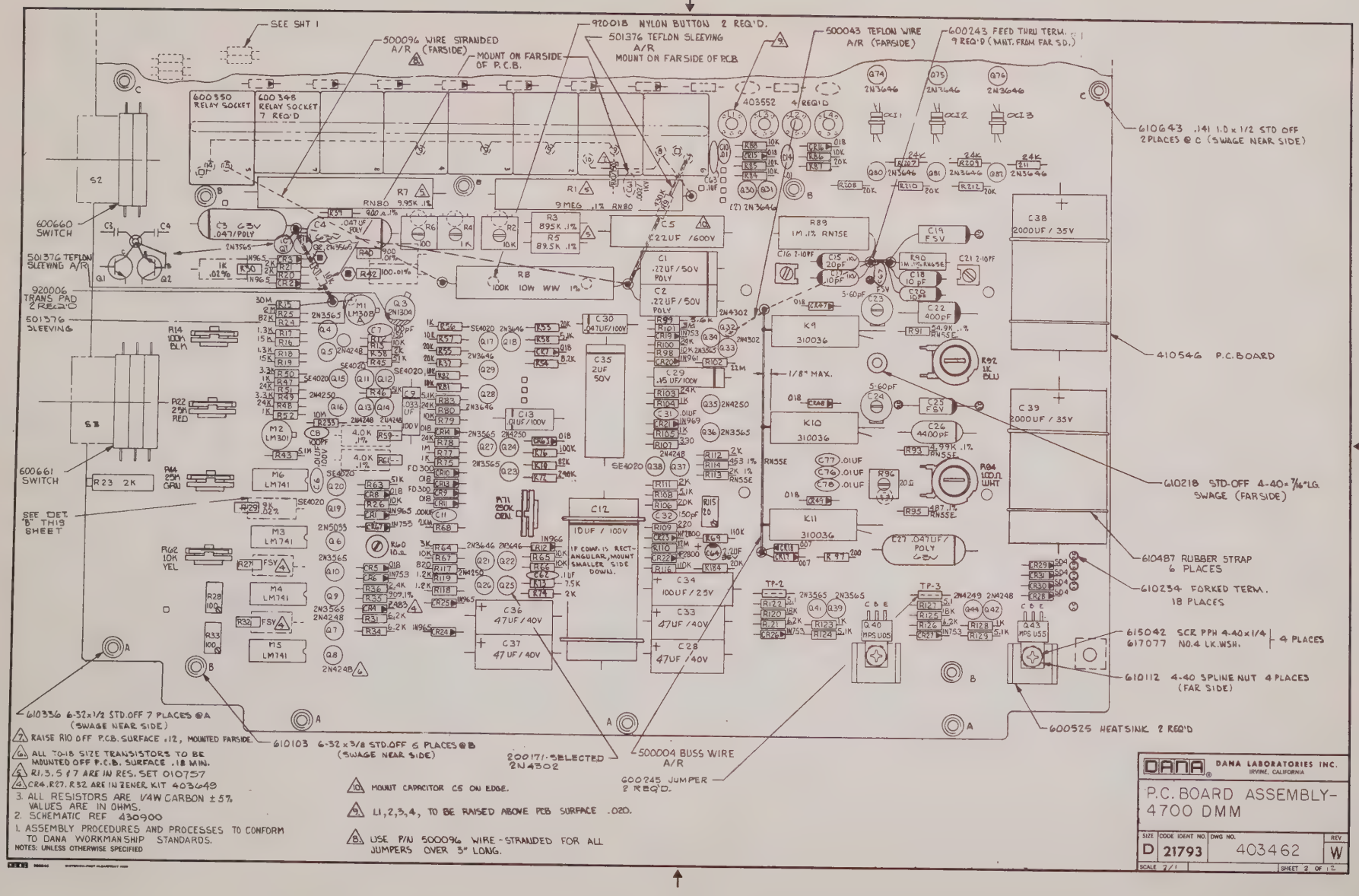
DANA DANA LABORATORIES INC. IRVINE, CALIFORNIA

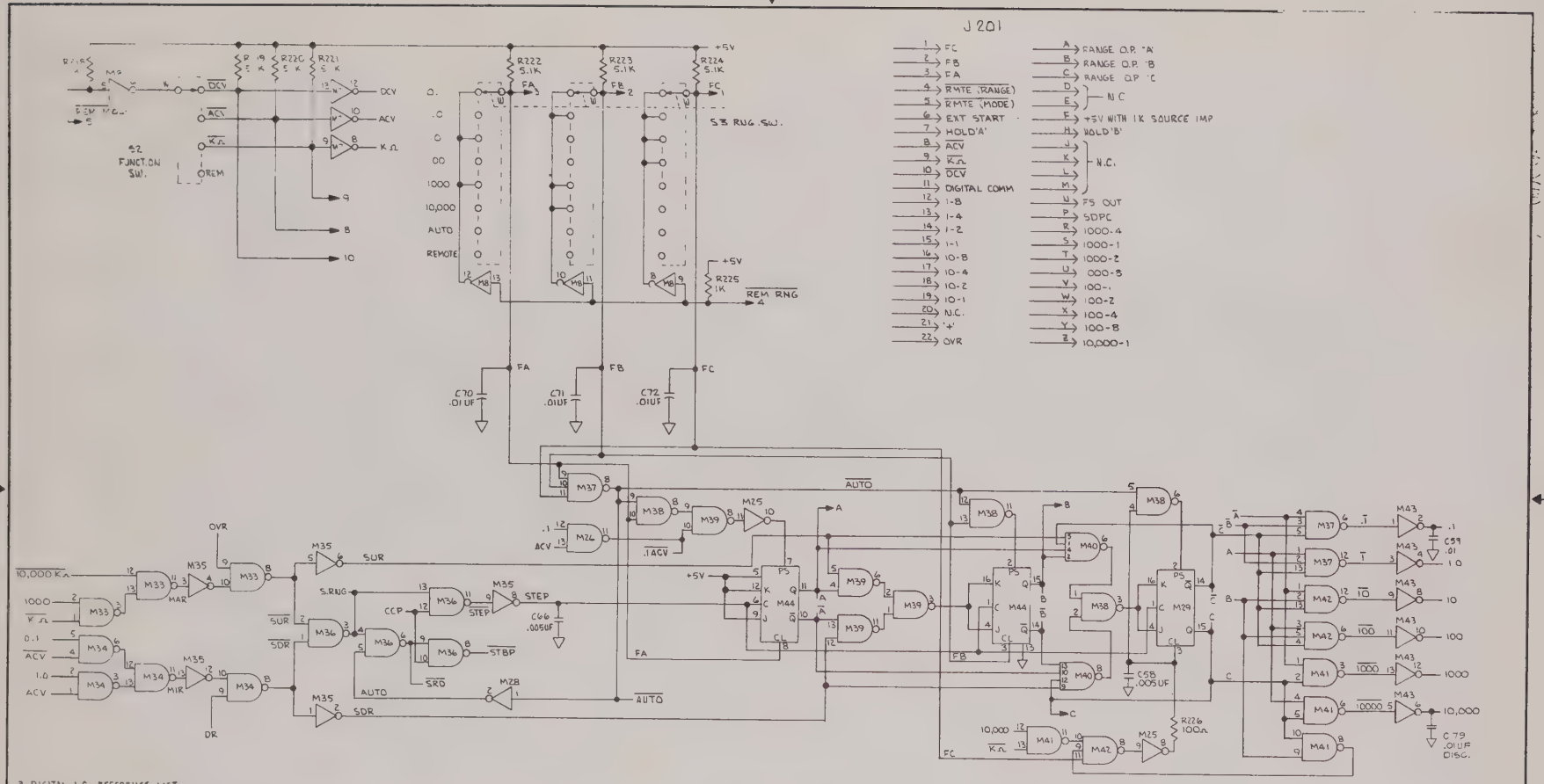
MODULE ASSY.- 4700 DMM

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	403461	M

SCALE 1/1 SHEET 2 OF 6


615042
PPH 4-40 x 1/4
617077
NO 4 LK WSH
2 PLACES-REF
610336 (REF.)
920419 IC SOCKET
16 PIN 10 PLACES
NOTE ORIENTATION
600591 POST-TEST POINT
8 REQ'D.
920460
IC SOCKET 14 PIN
32 PLACES
NOTE ORIENTATION
CAP. MTG. ON NEXT ASY.
SHOWN FOR REF ONLY.
45340
610019
BRACKET
RIVET
2 PLACES
FARSIDE
RAISE OFF P.C.B. SURFACE
.062 MIN. 12 PLACES.
501376
SLEEVING
A/R
920116
LAMP
6 REQ'D.
403420
HOUSING
2 REQ'D.
453464 INSERT
6 REQD. REF
920504
ADHESIVE
A/R
DETAIL 'A'
610112
2 REQD
REF.
920468
SOCKET
5 REQ'D
MOUNT OFF BRD
SURFACE .020
SEE
DETAIL 'A'
453576
SHIELD
M23 SN7473N
M21 SN7474N
M22 SN7473N
M29 SN7476N
M37 SN7410N
M36 SN7400N
M20 SN7490N
M28 SN7404N
M43 SN7404N
M34 SN7400N
M19 SN7475N
M25 SN7404N
M41 SN7400N
M33 SN7400N
M18 SN7441N
M17 SN7490N
M27 SN7420N
M42 SN7410N
M35 SN7404N
M15 SN7441N
M16 SN7475N
M24 SN7404N
M38 SN7400N
M30 SN7400N
M14 SN7490N
M26 SN7400N
M40 SN7420N
M12 SN7441N
M13 SN7475N
M44 SN7476N
M31 SN7403N
M9 SN7441N
M11 SN7490N
M39 SN7400N
M32 SN7400N
M10 SN7475N
M7 SN7404N
M8 SN7405
C52 .022UF
C55 6000UF / 10V
C54 22UF/ 6.3V
C53 22UF/ 6.3V
TO Q83 MTG. ON NEXT ASSY.
SEE SHEET 2
NOTES UNLESS OTHERWISE SPECIFIED
DANA
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
PC. BOARD ASSEMBLY-
4700 DMM
SIZE D
CODE IDENT NO. 21793
DWG NO 403462
REV W
SCALE 2X
SHEET 1 OF 12


SEE SHT 1
920018 NYLON BUTTON 2 REQ'D.
501376 TEFLON SLEEVING A/R MOUNT ON FARSIDE OF PCB
500096 WIRE STRANDED A/R (FARSIDE)
MOUNT ON FARSIDE OF P.C.B.
500043 TEFLON WIRE A/R (FARSIDE)
600243 FEED THRU TERM. 9 REQ'D (MNT. FROM FAR S.D.)
600350 RELAY SOCKET
600348 RELAY SOCKET 7 REQ'D
403552 4 REQ'D
610643 .141 I.D. x 1/2 STD OFF 2 PLACES @ C (SWAGE NEAR SIDE)
600660 SWITCH
501376 TEFLON SLEEVING A/R
920006 TRANS PAD 2 REQ'D
501376 SLEEVING
410546 P.C. BOARD
600661 SWITCH
610218 STD-OFF 4-40 x 7/16" LG. SWAGE (FARSIDE)
SEE DET. 'B' THIS SHEET
610487 RUBBER STRAP 6 PLACES
610234 FORKED TERM. 18 PLACES
615042 SCR PPH 4-40 x 1/4
617077 NO.4 LK.WSH.
4 PLACES
610112 4-40 SPLINE NUT 4 PLACES (FAR SIDE)
610336 6-32 x 1/2 STD.OFF 7 PLACES @ A (SWAGE NEAR SIDE)
610103 6-32 x 3/8 STD.OFF 6 PLACES @ B (SWAGE NEAR SIDE)
600525 HEATSINK 2 REQ'D
200171-3 SELECTED 2N4302
500004 BUSS WIRE A/R
600245 JUMPER 2 REQ'D.
1. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS.
2. SCHEMATIC REF 430900
3. ALL RESISTORS ARE 1/4W CARBON ±5% VALUES ARE IN OHMS.
NOTES: UNLESS OTHERWISE SPECIFIED
DANA LABORATORIES INC. IRVINE, CALIFORNIA
P.C. BOARD ASSEMBLY- 4700 DMM
SIZE D
CODE IDENT NO. 21793
DWG NO. 403462
REV. W
SCALE 2/1
SHEET 2 OF 12



3. DIGITAL I.C. REFERENCE LIST —

I.C. TYPE	VCC	COMM.	DESIGNATOR
SN7400N	14	7	M26,30,31,32,33,34,36,38,39,41
SN7404N	14	7	M37,24,25,28,35,43,
SN7405N	14	7	M8
SN7410N	14	7	M31, M42
SN7420N	14	7	M27, M40
SN7441N	16	12	M9,12,15,18
SN7473N	4	11	M23,23
SN7474N	14	7	M21
SN7475N	16	12	M10,13,16,19
SN7476N	16	13	M29, M44
SN7490N	16	10	M44,14,17,20

2. CAPACITANCE IS IN MICRO FARADS.

1. RESISTANCE IS IN OHMS, 1/4 WATT, CARBON, ± 5%.

NOTES: UNLESS OTHERWISE SPECIFIED

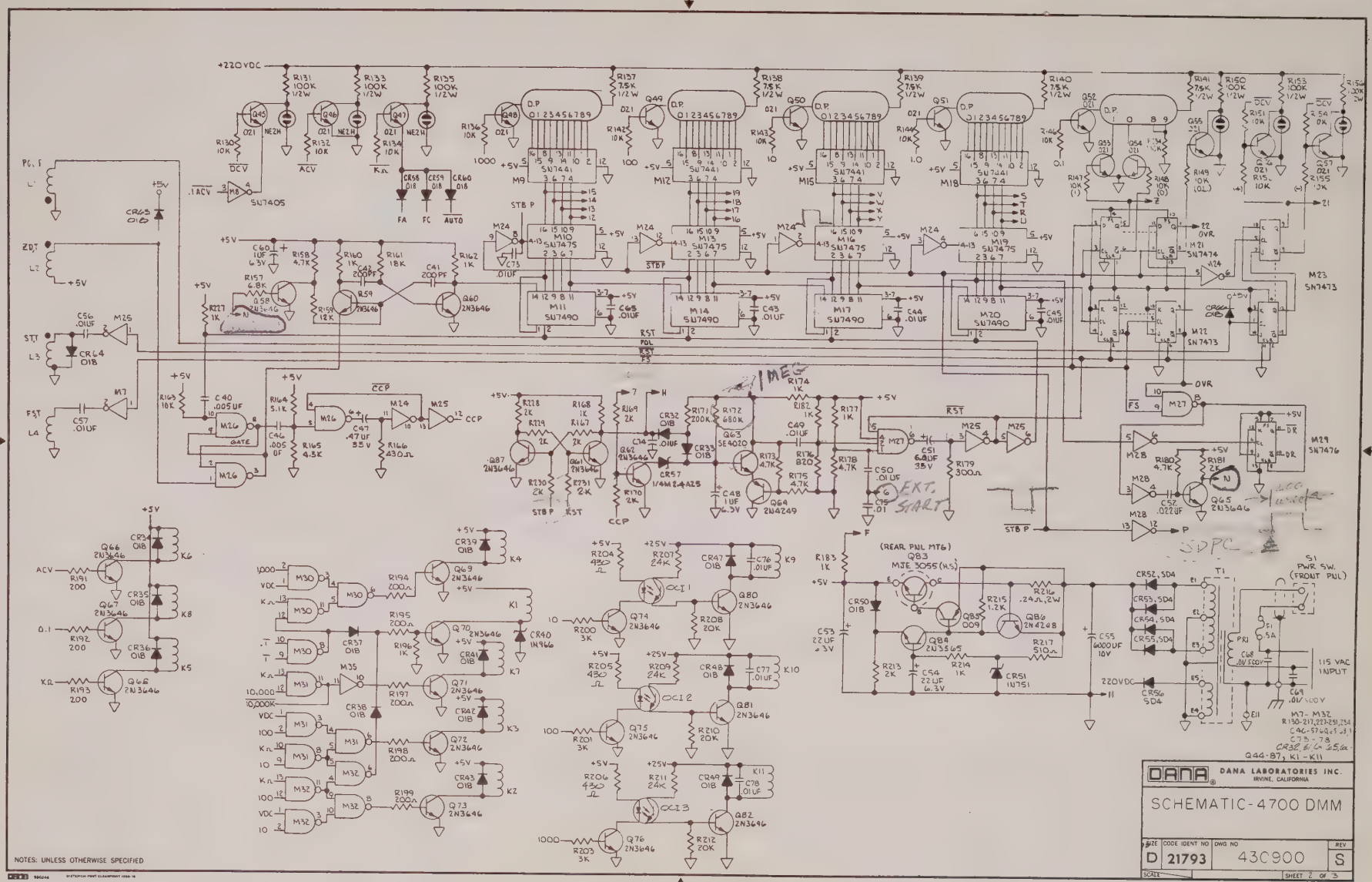
M33 - M44
R218 - 226
C58,59,66,70-72
79

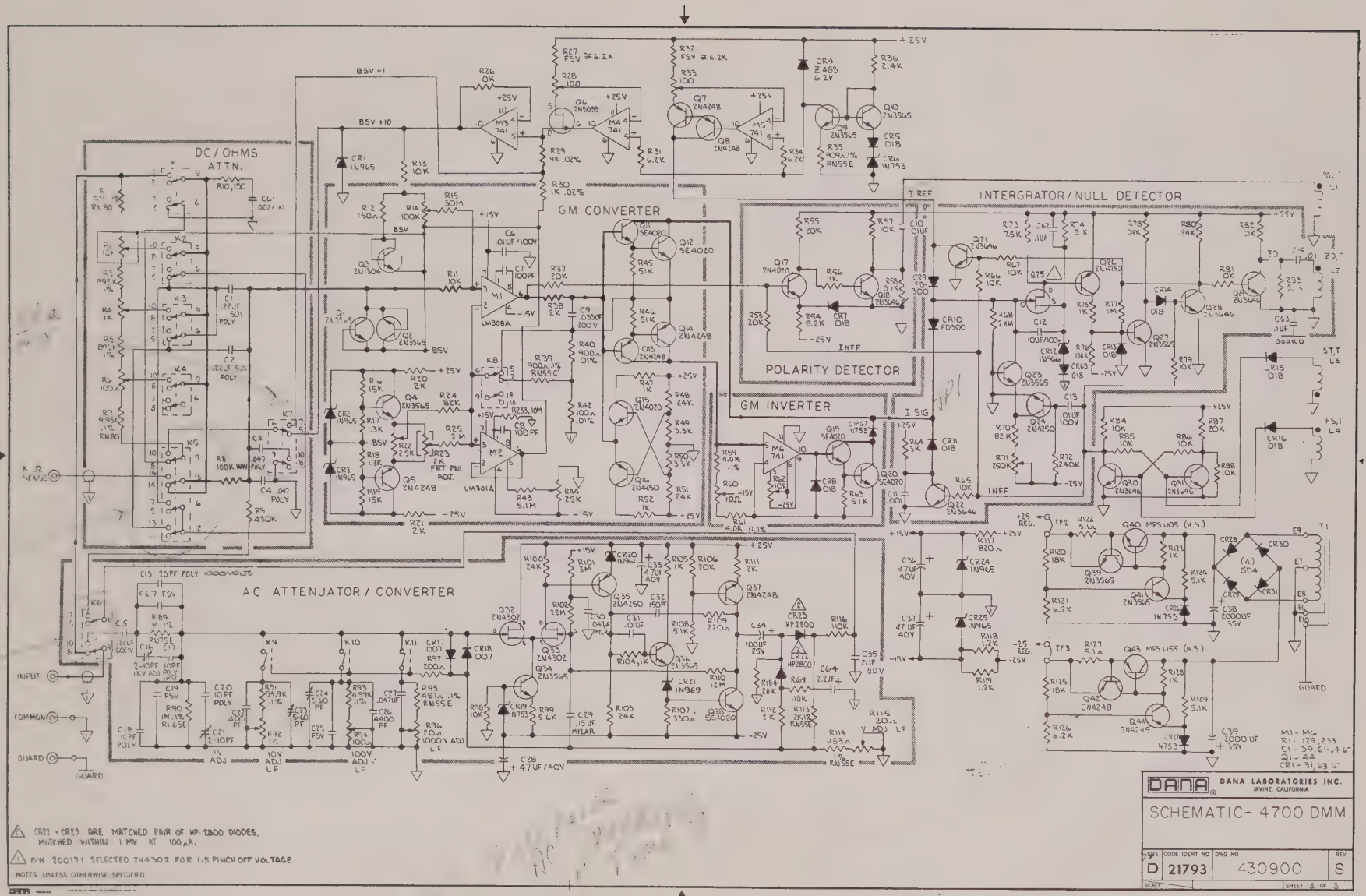
DANA DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC-4700 DMM

SIZE	CODE IDENT NO	DWG NO	REV
D	21793	430900	S

SCALE — SHEET OF 3


+220VDC
R131 100K 1/2W
R133 100K 1/2W
R135 100K 1/2W
Q45 NE2H
Q46 NE2H
Q47 NE2H
DCV
ACV
KΩ
CR58 .018
CR59 .018
CR60 .018
FA
FC
AUTO
SN7405
CR63 01D
+5V
ZDT
L2
ST.T
L3
FST
L4
M25
M7
CR64 01B
C56 .01UF
C57 .01UF
M26
GATE
C40 .005UF
C46 .005 UF
R163 10K
R164 5.1K
R165 4.5K
R166 430Ω
M24
M25
CCP
C60 1UF 6.3V
R158 4.7K
R160 1K
R161 18K
R162 1K
C62 200PF
C41 200PF
R157 6.8K
Q58 2N3646
R159 12K
R59 2N3646
Q60 2N3646
R227 1K
M10 SN7475
M11 SN7490
M12 SN7475
M13 SN7475
M14 SN7490
M15 SN7441
M16 SN7475
M17 SN7490
M18 SN7441
M19 SN7475
M20 SN7490
C65 .01UF
C43 .01UF
C44 .01UF
C45 .01UF
C73 .01UF
RST
POL
FS
STB P
R136 10K
R137 7.5K 1/2W
R138 7.5K 1/2W
R139 7.5K 1/2W
R140 7.5K 1/2W
R142 10K
R143 10K
R144 10K
R147 10K
R148 10K
Q48
Q49
Q50
Q51
Q52
Q53
Q54
Q55
Q56
Q57
R141 7.5K 1/2W
R150 100K 1/2W
R153 100K 1/2W
R151 10K
R155 10K
R149 10K
M21 SN7474
M22 SN7473
M23 SN7473
OVR
M27
M28
M29 SN7476
R174 1K
R177 1K
R182 1K
R171 200K
R172 680K
R173 4.7K
R175 4.7K
R176 820
R178 4.7K
R179 300Ω
R180 4.7K
R181 2K
Q63 SE4020
Q64 2N4249
Q65 2N3646
Q87 2N3646
Q88 2N3646
R228 2K
R229 2K
R168 1K
R167 2K
R69 2K
R230 2K
R231 2K
R170 2K
C49 .01UF
C50 .01 UF
C51 6.8UF 35V
C52 .022UF
C48 1UF 6.3V
C14 .01UF
CR32 01B
CR33 01B
CR57 1/4W24AZ5
CCP
EXT. START
1 MEG
100 MEG
SDPC
Q66 2N3646
Q67 2N3646
Q68 2N3646
CR34 01B
CR35 01B
CR36 01B
K6
K8
K5
R191 200
R192 200
R193 200
M30
M31
M32
M35
R194 200Ω
R195 200Ω
R196 1K
R197 200Ω
R198 200Ω
R199 200Ω
Q69 2N3646
Q70 2N3646
Q71 2N3646
Q72 2N3646
Q73 2N3646
CR39 01B
CR40 1N966
CR41 01B
CR42 01B
CR43 01B
CR37 01B
CR38 01B
K4
K1
K7
K3
K2
RZ04 430
RZ07 24K
RZ08 20K
RZ05 430
RZ09 24K
RZ10 20K
RZ06 430
RZ11 24K
RZ12 20K
RZ00 3K
RZ01 3K
RZ03 3K
OCI 1
OCI 2
OCI 3
Q74 2N3646
Q75 2N3646
Q76 2N3646
Q80 2N3646
Q81 2N3646
Q82 2N3646
CR47 01B
CR48 01B
CR49 01B
K9
K10
K11
C76 .01UF
C77 .01UF
C78 .01UF
(REAR PNL MT6)
Q83 MJE 3055 (N.S.)
R183 1K
CR50 01B
C53 22UF 3V
R215 1.2K
R216 .24Ω, 2W
Q85 009
Q86 2N4248
Q84 2N3365
R217 510Ω
R213 2K
C54 22UF 6.3V
R214 1K
CR51 1N751
C55 6000UF 10V
220VDC
CR52, SD4
CR53, SD4
CR54, SD4
CR55, SD4
CR56 SD4
T1
PRI
S1 PWR SW. (FRONT PNL)
5A
C68 .01 500V
C69 .01 500V
115 VAC INPUT
M7-M32
R130-217, 223-251, 254
C40-57, 62-65, 73-78
CR32, 33, 63, 65, 66
Q44-87, K1-K11
NOTES: UNLESS OTHERWISE SPECIFIED
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC-4700 DMM
SIZE D
CODE IDENT NO 21793
DWG NO 430900
REV S
SCALE
SHEET 2 OF 3



⚠ CR22 + CR23 ARE MATCHED PAIR OF HP-2800 DIODES. MATCHED WITHIN 1 MV AT 100 μA.

⚠ P/N 200171 SELECTED 2N4302 FOR 1.5 PINCH OFF VOLTAGE

NOTES: UNLESS OTHERWISE SPECIFIED

4700A RELAY LOGIC EQUATIONS

K1 = (0.1) + (1) + (KΩ · 10) + (KΩ · 100)

K2 = (KΩ · 100) + (VDC · 10)

K3 = (VDC · 100) + (KΩ · 10)

K4 = (VDC · 1000) + (KΩ · 0.1) + (KΩ · 1)

K5 = KΩ

K6 = AC

K7 = (KΩ · 10,000) + 10,000

K8 = 0.1

"0" = Deenergized
"1" = Energized

RELAY LOGIC TABLE

	DC					AC				KΩ					
RANGE	.1	1	10	100	1000	1	10	100	1000	.1	1	10	100	1000	10K
K1	1	1	0	0	0	1	0	0	0	1	1	1	1	0	0
K2	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0
K3	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
K4	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0
K5	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
K6	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0
K7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
K8	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0

PARTS LIST

ASSEMBLY 403461 - 4700A

REF. DESIG.	PART NO.	DESCRIPTION				
C55	110128	CAP	6000 MFD 10 V		SPRAGUE	36D602G010AA2A
C68	100063	CAP	.01 MFD 500 V	20%	SPRAGUE	5GAS-S10
C69	100063	CAP	.01 MFD 500 V	20%	SPRAGUE	5GAS-S10
Q80	200130	TRANS			MOTOROLA	MJE3055

PARTS LIST

ASSEMBLY 403462 - 4700A

REF. DESIG.	PART NO.	DESCRIPTION	
CR01	220022	DIODE SILICO ZENER 1N965B	MOTOROLA 1N965B
CR02	220022	DIODE SILICO ZENER 1N965B	MOTOROLA 1N965B
CR03	220022	DIODE SILICO ZENER 1N965B	MOTOROLA 1N965B
CR04	403463	ASSY	DANA 403463
CR05	211083	DIODE SILICO 018	DANA 211083
CR06	220040	DIODE ZENER	SEMCOR 1N753
CR07	211083	DIODE SILICO 018	DANA 211083
CR08	211083	DIODE SILICO 018	DANA 211083
CR09	210036	DIODE	
CR10	210036	DIODE	
CR11	211083	DIODE SILICO 018	DANA 211083
CR12	220035	DIODE ZENER IN966B	MOTOROLA IN966B
CR13	211083	DIODE SILICO 018	DANA 211083
CR14	211083	DIODE SILICO 018	DANA 211083
CR15	211083	DIODE SILICO 018	DANA 211083
CR16	211083	DIODE SILICO 018	DANA 211083
CR17	211236	DIODE SILICO 007	DANA 211236
CR18	211236	DIODE SILICO 007	DANA 211236
CR19	220040	DIODE, ZENER	SEMCOR 1N753
CR20	220004	DIODE SILICO ZENER 1N961B	MOTOROLA 1N961B
CR21	221255	DIODE SILICO ZENER 1N969A	MOTOROLA 1N969A
CR22	210042	DIODE MATCHED PAIR	DANA 210042
CR23	210042	DIODE MATCHED PAIR	DANA 210042
CR24	220022	DIODE SILICO ZENER 1N965B	MOTOROLA 1N965B
CR25	220022	DIODE SILICO ZENER 1N965B	MOTOROLA 1N965B
CR26	220040	DIODE ZENER	SEMCOR 1N753
CR27	220040	DIODE ZENER	SEMCOR 1N753
CR28	210004	DIODE SILICO SD4	DIODES IN SD4
CR29	210004	DIODE SILICO SD4	DIODES IN SD4
CR30	210004	DIODE SILICO SD4	DIODES IN SD4
CR31	210004	DIODE SILICO SD4	DIODES IN SD4
CR32	211083	DIODE SILICO 018	DANA 211083
CR33	211083	DIODE SILICO 018	DANA 211083
CR34	211083	DIODE SILICO 018	DANA 211083
CR35	211083	DIODE SILICO 018	DANA 211083
CR36	211083	DIODE SILICO 018	DANA 211083

PARTS LIST

ASSEMBLY 403462 - 4700A

A

REF. DESIG.	PART NO.	DESCRIPTION		
CR37	211083	DIODE SILICO 018	DANA	211083
CR38	211083	DIODE SILICO 018	DANA	211083
CR39	211083	DIODE SILICO 018	DANA	211083
CR40	220035	DIODE ZENER IN966B	MOTOROLA	IN966B
CR41	211083	DIODE SILICO 018	DANA	211083
CR42	211083	DIODE SILICO 018	DANA	211083
CR43	211083	DIODE SILICO 018	DANA	211083
CR47	211083	DIODE SILICO 018	DANA	211083
CR48	211083	DIODE SILICO 018	DANA	211083
CR49	211083	DIODE SILICO 018	DANA	211083
CR50	211083	DIODE SILICO 018	DANA	211083
CR51	220007	DIODE SILICO ZENER 1N751	MOTOROLA	1N751
CR52	210004	DIODE SILICO SD4	DIODES IN SD4	
CR53	210004	DIODE SILICO SD4	DIODES IN SD4	
CR54	210004	DIODE SILICO SD4	DIODES IN SD4	
CR55	210004	DIODE SILICO SD4	DIODES IN SD4	
CR56	210004	DIODE SILICO SD4	DIODES IN SD4	
CR57	221177	DIODE SILICO ZENER 1/4 W	MOTOROLA	M.2.4A25
CR58	211083	DIODE SILICO 018	DANA	211083
CR59	211083	DIODE SILICO 018	DANA	211083
CR60	211083	DIODE SILICO 018	DANA	211083
CR63	211083	DIODE SILICO 018	DANA	211083
CR64	211083	DIODE SILICO 018	DANA	211083
CR65	211083	DIODE SILICO 018	DANA	211083
CR67	220012	DIODE SILICO ZENER 1N958B	MOTOROLA	1N958B
C01	120267	CAP POLY .22 MFD, 50 V	IMB	PA2A224K
C02	120267	CAP POLY .22 MFD, 50 V	IMB	PA2A224K
C03	120161	CAP POLY .047 MFD, 63 V 2.5%	DIEL	N100
C04	120161	CAP POLYS .047 MFD 63 V 2.5%	DIEL	N100
C05	120007	CAP MYLAR .22 MFD 600 V 20%	ELEC CUBE	210B1F224
C06	100017	CAP CERAM .01 MFD 200 V 10%	SPRAGUE	TH-S10
C07	101145	CAP CERAM 100 PFD 500 V 10%	AEROVOX	SCD1X5F
C08	101145	CAP CERAM 100 PFD 500 V 10%	AEROVOX	SCD1X5F
C09	121091	CAP MYLAR .033 MFD 100 V 10%	CDE	WMF1533

PARTS LIST

ASSEMBLY 403462 - 4700A

REF. DESIG.	PART NO.	DESCRIPTION						
C10	100017	CAP	CERAM	.01 MFD	200 V	10%	SPRAGUE	TH-S10
C11	101174	CAP	CERAM	.001 MFD	500 V	10%	AERCVOX	SC03X5F
C12	120265	CAP	MYLAR	10 MFD	100 V		IMB	ZA2B106J
C13	121088	CAP	MYLAR	.01 MFD	100 V	10%	CDE	WMF1S1
C14	100017	CAP	CERAM	.01 MFD	200 V	10%	SPRAGUE	TH-S10
C15	120197	CAP	POLYS	20 PFD	1000 V		DUCATI	20-1000
C16	130077	CAP		1.8 PF	500 V		AMPEREX	2222-809-05002
C17	120279	CAP	POLY	10 PF	1000 V		NPC	KSO SERIES
C18	120218	CAP	POLY	10 PF	630 V		MALLORY	SX410
C19	120142	CAP	POLYS	FSV			DANA	120142
C20	120218	CAP	POLY	10 PF	630 V		MALLORY	SX410
C21	130077	CAP		1.8 PF	500 V		AMPEREX	2222-809-05002
C22	120165	CAP	POLYS	400 PFD	63 V	2.5%	MIAL	611
C23	130055	CAP	CERAM	5-60 PFD		10%	AMPREX	C010MA/60E
C24	130055	CAP	CERAM	5-60 PFD		10%	AMPREX	C010MA/60E
C25	120142	CAP	POLYS	FSV			DANA	120142
C26	120162	CAP	POLYS	.0044 MFD	63 V	2.5%	MIAL	611.20
C27	120161	CAP	POLYS	.047 MFD	63 V	2.5%	DIEL	N100
C28	110145	CAP	ELECT	50 MFD	40 V			
C29	121394	CAP	MYLAR	.15 MFD	100 V	10%	CDE	WMF1P15
C30	121093	CAP	MYLAR	.047 MFD	100 V	10%	CDE	WMF1S47
C31	100017	CAP	CERAM	.01 MFD	200 V	10%	SPRAGUE	TH-S10
C32	101642	CAP	CERAM	150 PFD	500 V	10%	AERCVOX	SC02X5F
C33	110145	CAP	ELECT	50 MFD	40 V			
C34	111146	CAP	ELECT	100 MFD	25 V	20%	SPRAGUE	TE1211
C35	120266	CAP	MYLAR	2 MFD	50 V	5%	IMB	XA2A205J
C36	110145	CAP	ELECT	50 MFD	40 V			
C37	110145	CAP	ELECT	50 MFD	40 V			
C38	110067	CAP	ELECT	2000 MFD	35 V	20%	DUCATI	2000-35
C39	110067	CAP	ELECT	2000 MFD	35 V	20%	DUCATI	2000-35
C40	100025	CAP	CERAM	.005 MFD	100 V	20%	ERIE	831-000-X5V05
C41	120183	CAP	POLY	200 PFD	630 V	5%	NPC	KSO
C42	120183	CAP	POLY	200 PFD	630 V	5%	NPC	KSO
C43	100017	CAP	CERAM	.01 MFD	200 V	10%	SPRAGUE	TH-S10
C44	100017	CAP	CERAM	.01 MFD	200 V	10%	SPRAGUE	TH-S10

PARTS LIST

A

ASSEMBLY 403462 - 4700A

REF. DESIG.	PART NO.	DESCRIPTION						
C45	100017	CAP	CERAM	.01 MFD	200 V	10%	SPRAGUE	TH-S10
C46	100025	CAP	CERAM	.005 MFD	100 V	20%	ERIE	835-000-X5V05
C47	110137	CAP	TANT	.47 MFD	35 V		ITT	43212/17047
C48	110143	CAP	TANT	1 MFD	35 V			
C49	100017	CAP	CERAM	.01 MFD	200 V	10%	SPRAGUE	TH-S10
C50	100017	CAP	CERAM	.01 MFD	200 V	10%	SPRAGUE	TH-S10
C51	110126	CAP	TANT	6.8 MFD	35 V		ITT	4312 17168
C52	121468	CAP	MYLAR	.022 MFD	100 V	10%	CDE	WMF1S22
C53	110127	CAP	TANT	22 MFD	6.3 V		ITT	43212 12222
C54	110127	CAP	TANT	22 MFD	6.3 V		ITT	43212 12222
C55	110128	CAP		6000 MFD	10 V		SPRAGUE	36D602G010AA2A
C56	100017	CAP	CERAM	.01 MFD	200 V	10%	SPRAGUE	TH-S10
C57	100017	CAP	CERAM	.01 MFD	200 V	10%	SPRAGUE	TH-S10
C58	100025	CAP	CERAM	.005 MFD	100 V	20%	ERIE	835-000-X5V05
C59	100017	CAP	CERAM	.01 MFD	200 V	10%	SPRAGUE	TH-S10
C60	110143	CAP	TANT	1 MFD	35 V			
C61	100019	CAP	CERAM	.002 MFD	10000V		SPRAGUE	5GA-D20
C62	100057	CAP	DISC				SPRAGUE	5GA-P10
C63	100057	CAP	DISC				SPRAGUE	5GA-P10
C64	110125	CAP	TANT	2.2 MFD	35 V		ITT	43212 17122
C65	100017	CAP	CERAM	.01 MFD	200 V	10%	SPRAGUE	TH-S10
C66	100025	CAP	CERAM	.005 MFD	100 V	20%	ERIE	835-000-X5V05
C67	120142	CAP	POLYS	FSV			DANA	120142
C70 thru C79	100017	CAP	CERAM	.01 MFD	200 V	10%	SPRAGUE	TH-S10
K09	310036	RELAY REED					ELEC-TROL	R2096-3
K10	310036	RELAY REED					ELEC-TROL	R2096-3
K11	310036	RELAY REED					ELEC-TROL	R2096-3
L01	403552	TRANSFORMER, PULSE						
L02	403552	TRANSFORMER, PULSE						
L03	403552	TRANSFORMER, PULSE						
L04	403552	TRANSFORMER, PULSE						
M01	230085	INTEGRATED CIRCUIT	LM308A				NAT SEMI	LM308A
M02	230054	INTEGRATED CIRCUIT	LM301A				NAT SEMI	LM301A
M03	230045	INTEGRATED CIRCUIT	UA741C				FAIRCHILD	UA741C

PARTS LIST

ASSEMBLY 403462 - 4700A

REF. DESIG.	PART No.	DESCRIPTION			
M04	230045	INTEGRATED CIRCUIT	UA741C	FAIRCHILD	UA741C
M05	230045	INTEGRATED CIRCUIT	UA741C	FAIRCHILD	UA741C
M06	230045	INTEGRATED CIRCUIT	UA741C	FAIRCHILD	UA741C
M07	230064	INTEGRATED CIRCUIT		TI	SN7404N
M08	230073	INTEGRATED CIRCUIT		LIBERTY	SN7405N
M09	230034	INTEGRATED CIRCUIT		TI	SN7441N
M10	230065	INTEGRATED CIRCUIT		TI	SN7475N
M11	230037	INTEGRATED CIRCUIT		TI	SN7490N
M12	230034	INTEGRATED CIRCUIT		TI	SN7441N
M13	230065	INTEGRATED CIRCUIT		TI	SN7475N
M14	230037	INTEGRATED CIRCUIT		TI	SN7490N
M15	230034	INTEGRATED CIRCUIT		TI	SN7441N
M16	230065	INTEGRATED CIRCUIT		TI	SN7475N
M17	230037	INTEGRATED CIRCUIT		TI	SN7490N
M18	230034	INTEGRATED CIRCUIT		TI	SN7441N
M19	230065	INTEGRATED CIRCUIT		TI	SN7475N
M20	230037	INTEGRATED CIRCUIT		TI	SN7490N
M21	230072	INTEGRATED CIRCUIT		TI	SN7474N
M22	230035	INTEGRATED CIRCUIT		TI	SN7473N
M23	230035	INTEGRATED CIRCUIT		TI	SN7473N
M24	230064	INTEGRATED CIRCUIT		TI	SN7404N
M25	230064	INTEGRATED CIRCUIT		TI	SN7404N
M26	230026	INTEGRATED CIRCUIT		TI	SN7400N
M27	230032	INTEGRATED CIRCUIT		TI	SN7420N
M28	230064	INTEGRATED CIRCUIT		TI	SN7404N
M29	230093	INTEGRATED CIRCUIT		LIBERTY	SN7476N
M30	230028	INTEGRATED CIRCUIT		TI	SN7400N
M31	230028	INTEGRATED CIRCUIT		TI	SN7400N
M32	230028	INTEGRATED CIRCUIT		TI	SN7400N
M33	230028	INTEGRATED CIRCUIT		TI	SN7400N
M34	230028	INTEGRATED CIRCUIT		TI	SN7400N
M35	230064	INTEGRATED CIRCUIT		TI	SN7404N
M36	230026	INTEGRATED CIRCUIT		TI	SN7400N
M37	230031	INTEGRATED CIRCUIT		TI	SN7410N
M38	230028	INTEGRATED CIRCUIT		TI	SN7400N

OC11,12,13

250000 Isolator, optically coupled TIL108 01295 TIL108

PARTS LIST

ASSEMBLY 403462 - 4700A

A

REF. DESIG.	PART NO.	DESCRIPTION		
M39	230028	INTEGRATED CIRCUIT		TI SN7400N
M40	230032	INTEGRATED CIRCUIT		TI SN7420N
M41	230028	INTEGRATED CIRCUIT		TI SN7400N
M42	230031	INTEGRATED CIRCUIT		TI SN7410N
M43	230064	INTEGRATED CIRCUIT		TI SN7404N
M44	230093	INTEGRATED CIRCUIT		LIBERTY SN7476N
Q01	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q02	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q03	201084	TRANS GERMAN PNP	2N1304	TI 2N1304
Q04	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q05	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q06	200185	TRANS	2N5033	FAIRCHILD 2N5033
Q07	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q08	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q09	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q10	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q11	200129	TRANS		FAIRCHILD SE4020
Q12	200129	TRANS		FAIRCHILD SE4020
Q13	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q14	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q15	200129	TRANS		FAIRCHILD SE4020
Q16	200068	TRANS	2N4250	FAIRCHILD 2N4250
Q17	200129	TRANS		FAIRCHILD SE4020
Q18	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q19	200129	TRANS		FAIRCHILD SE4020
Q20	200129	TRANS		FAIRCHILD SE4020
Q21	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q22	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q23	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q24	200068	TRANS	2N4250	FAIRCHILD 2N4250
Q25	200171	TRANS SELECT		DANA 200171
Q26	200068	TRANS	2N4250	FAIRCHILD 2N4250
Q27	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q28	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q29	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646

PARTS LIST

ASSEMBLY 403462 - 4700A

REF. DESIG.	PART NO.	DESCRIPTION		
Q30	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q31	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q32	200107	TRANS N-CHAN FIELD EFFECT		FAIRCHILD 2N4302
Q33	200107	TRANS N-CHAN FIELD EFFECT		FAIRCHILD 2N4302
Q34	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q35	200068	TRANS	2N4250	FAIRCHILD 2N4250
Q36	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q37	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q38	200129	TRANS		FAIRCHILD 2N4249
Q39	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q40	200166	TRANS		MOTOROLA MPSU05
Q41	200043	TRANS SILICO NPN	2N3565	FAIRCHILD 2N3565
Q42	200088	TRANS SILICO PNP	2N4248	FAIRCHILD 2N4248
Q43	200167	TRANS		MOTOROLA MPSU55
Q44	200142	TRANS		FAIRCHILD 2N4249
Q45	200087	TRANS SILICO	021	MOTOROLA SPS1226
Q46	200087	TRANS SILICO	021	MOTOROLA SPS1226
Q47	200087	TRANS SILICO	021	MOTOROLA SPS1226
Q48	200087	TRANS SILICO	021	MOTOROLA SPS1226
Q49	200087	TRANS SILICO	021	MOTOROLA SPS1226
Q50	200087	TRANS SILICO	021	MOTOROLA SPS1226
Q51	200087	TRANS SILICO	021	MOTOROLA SPS1226
Q52	200087	TRANS SILICO	021	MOTOROLA SPS1226
Q53	200087	TRANS SILICO	021	MOTOROLA SPS1226
Q54	200087	TRANS SILICO	021	MOTOROLA SPS1226
Q55	200087	TRANS SILICO	021	MOTOROLA SPS1226
Q56	200087	TRANS SILICO	021	MOTOROLA SPS1226
Q57	200087	TRANS SILICO	021	MOTOROLA SPS1226
Q58	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q59	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q60	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q61	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q62	200037	TRANS SILICO NPN	2N3646	FAIRCHILD 2N3646
Q63	200129	TRANS		FAIRCHILD SE4020
Q64	200142	TRANS		FAIRCHILD 2N4249

PARTS LIST

ASSEMBLY 403462 - 4700A

A

REF. DESIG.	PART NO.	DESCRIPTION				
Q65	200037	TRANS SILICO NPN	2N3646			FAIRCHILD 2N3646
Q66	200037	TRANS SILICO NPN	2N3646			FAIRCHILD 2N3646
Q67	200037	TRANS SILICO NPN	2N3646			FAIRCHILD 2N3646
Q68	200037	TRANS SILICO NPN	2N3646			FAIRCHILD 2N3646
Q69	200037	TRANS SILICO NPN	2N3646			FAIRCHILD 2N3646
Q70	200037	TRANS SILICO NPN	2N3646			FAIRCHILD 2N3646
Q71	200037	TRANS SILICO NPN	2N3646			FAIRCHILD 2N3646
Q72	200037	TRANS SILICO NPN	2N3646			FAIRCHILD 2N3646
Q73	200037	TRANS SILICO NPN	2N3646			FAIRCHILD 2N3646
Q74	200037	TRANS SILICO NPN	2N3646			FAIRCHILD 2N3646
Q75	200037	TRANS SILICO NPN	2N3646			FAIRCHILD 2N3646
Q76	200037	TRANS SILICO NPN	2N3646			FAIRCHILD 2N3646
Q80	200037	TRANS SILICO NPN	2N3646			FAIRCHILD 2N3646
Q81	200037	TRANS SILICO NPN	2N3646			FAIRCHILD 2N3646
Q82	200037	TRANS SILICO NPN	2N3646			FAIRCHILD 2N3646
Q83	200130	TRANS				MOTOROLA MJE3055
Q84	200043	TRANS SILICO NPN	2N3565			FAIRCHILD 2N3565
Q85	200052	TRANS SILICO PNP	009			DANA 200052
Q86	200088	TRANS SILICO PNP	2N4248			FAIRCHILD 2N4248
Q87	200037	TRANS SILICO NPN	2N3646			FAIRCHILD 2N3646
R01	010759	RES SET				
R02	040197	POT	10K			CTS 360T
R03	010757	RES SET				
R04	040196	POT	1K			CTS 360T
R05	010757	RES SET				
R06	040193	POT	100 OHM			CTS 360T
R07	010757	RES SET				
R08	030015	RES WW	100 K	1%	10 W	C-F M-100
R09	000434	RES CARBON	430 K	5%	1/4 W	OHMITE RC07GF434J
R10	000151	RES CARBON	150 OHM	5%	1/4 W	OHMITE RC07GF151J
R100	000243	RES CARBON	24 K	5%	1/4 W	OHMITE RC07GF243J
R101	000305	RES CARBON	3 M	5%	1/4 W	OHMITE RC07GF305J

PARTS LIST

ASSEMBLY 403462 - 4700A

A

REF. DESIG.	PART NO.	DESCRIPTION						
R102	000226	RES	CARBON	22 M	5%	1/4 W	OHMITE	RC07GF226J
R103	000243	RES	CARBON	24 K	5%	1/4 W	OHMITE	RC07GF243J
R104	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R105	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R106	000203	RES	CARBON	20 K	5%	1/4 W	OHMITE	RC07GF203J
R107	000331	RES	CARBON	330 OHM	5%	1/4 W	OHMITE	RC07GF331J
R108	000512	RES	CARBON	5.1 K	5%	1/4 W	OHMITE	RC07GF512J
R109	000221	RES	CARBON	220 OHM	5%	1/4 W	OHMITE	RC07GF221J
R11	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R110	000126	RES	CARBON	12 M	5%	1/4 W	OHMITE	RC07GF126J
R111	000202	RES	CARBON	2 K	5%	1/4 W	OHMITE	RC07GF202J
R112	000202	RES	CARBON	2 K	5%	1/4 W	OHMITE	RC07GF202J
R113	010530	RES	METAL FILM	2 K	1%		IRC	RN55E
R114	010707	RES		453 OHM	1%		IRC	RN55E
R115	040128	POT		20 OHM			IRC	700-208
R116	000114	RES	CARBON	110 K	5%	1/4 W	OHMITE	RC07GF114J
R117	000821	RES	CARBON	820 OHM	5%	1/4 W	OHMITE	RC07GF821J
R118	000122	RES	CARBON	1.2 K	5%	1/4 W	OHMITE	RC07GF122J
R119	000122	RES	CARBON	1.2 K	5%	1/4 W	OHMITE	RC07GF122J
R12	000151	RES	CARBON	150 OHM	5%	1/4 W	OHMITE	RC07GF151J
R120	000183	RES	CARBON	18 K	5%	1/4 W	OHMITE	RC07GF183J
R121	000622	RES	CARBON	6.2 K	5%	1/4 W	OHMITE	RC07GF622J
R122	001759	RES	CARBON	5.1 OHM	5%	1/4 W		
R123	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R124	000512	RES	CARBON	5.1 K	5%	1/4 W	OHMITE	RC07GF512J
R125	000183	RES	CARBON	18 K	5%	1/4 W	OHMITE	RC07GF183J
R126	000622	RES	CARBON	6.2 K	5%	1/4 W	OHMITE	RC07GF622J
R127	001759	RES	CARBON	5.1 OHM	5%	1/4 W		
R128	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R129	000512	RES	CARBON	5.1 K	5%	1/4 W	OHMITE	RC07GF512J
R13	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R130	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R131	001718	RES	CARBON	0.10 MEG	5%	1/2 W	OHMITE	RC20GF104J
R132	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R133	001718	RES	CARBON	0.10 MEG	5%	1/2 W	OHMITE	RC20GF104J

PARTS LIST

ASSEMBLY 403462 - 4700A

A

REF. DESIG.	PART NO.	DESCRIPTION							
R134	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R135	001718	RES	CARBON	0.10	MEG	5%	1/2	W	OHMITE	RC20GF104J
R136	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R137	001681	RES	CARBON	7.5	K	5%	1/2	W	OHMITE	RC20GF752J
R138	001681	RES	CARBON	7.5	K	5%	1/2	W	OHMITE	RC20GF752J
R139	001681	RES	CARBON	7.5	K	5%	1/2	W	OHMITE	RC20GF752J
R14	040271	POT	CARBON	100	K	20%	.25	W	CTS	X201
R140	001681	RES	CARBON	7.5	K	5%	1/2	W	OHMITE	RC20GF752J
R141	001681	RES	CARBON	7.5	K	5%	1/2	W	OHMITE	RC20GF752J
R142	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R143	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R144	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R146	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R147	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R148	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R149	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R15	000306	RES	CARBON	30	M	5%	1/4	W	OHMITE	RC07GF306J
R150	001718	RES	CARBON	0.10	MEG	5%	1/2	W	OHMITE	[illegible]
R151	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	[illegible]
R152	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R153	001718	RES	CARBON	0.10	MEG	5%	1/2	W	OHMITE	RC20GF104J
R154	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R155	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R156	001718	RES	CARBON	0.10	MEG	5%	1/2	W	OHMITE	RC20GF104J
R157	000682	RES	CARBON	6.8	K	5%	1/4	W	OHMITE	RC07GF682J
R158	000472	RES	CARBON	4.7	K	5%	1/4	W	OHMITE	RC07GF472J
R159	000123	RES	CARBON	12	K	5%	1/4	W	OHMITE	RC07GF123J
R16	000153	RES	CARBON	15	K	5%	1/4	W	OHMITE	RC07GF153J
R160	000102	RES	CARBON	1	K	5%	1/4	W	OHMITE	RC07GF102J
R161	000183	RES	CARBON	18	K	5%	1/4	W	OHMITE	RC07GF183J
R162	000102	RES	CARBON	1	K	5%	1/4	W	OHMITE	RC07GF102J
R163	000103	RES	CARBON	10	K	5%	1/4	W	OHMITE	RC07GF103J
R164	000512	RES	CARBON	5.1	K	5%	1/4	W	OHMITE	RC07GF512J
R165	000432	RES	CARBON	4.3	K	5%	1/4	W	OHMITE	RC07GF432J

PARTS LIST

ASSEMBLY 403462 - 4700A

REF. DESIG.	PART NO.	DESCRIPTION						
R166	000431	RES	CARBON	430 OHM	5%	1/4 W	OHMITE	RC07GF431J
R167	000202	RES	CARBON	2 K	5%	1/4 W	OHMITE	RC07GF202J
R168	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R169	000202	RES	CARBON	2 K	5%	1/4 W	OHMITE	RC07GF202J
R17	000132	RES	CARBON	1.3 K	5%	1/4 W	OHMITE	RC07GF132J
R170	000202	RES	CARBON	2 K	5%	1/4 W	OHMITE	RC07GF202J
R171	000204	RES	CARBON	200 K	5%	1/4 W	OHMITE	RC07GF204J
R172	000684	RES	CARBON	680 K	5%	1/4 W	OHMITE	RC07GF684J
R173	000472	RES	CARBON	4.7 K	5%	1/4 W	OHMITE	RC07GF472J
R174	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R175	000472	RES	CARBON	4.7 K	5%	1/4 W	OHMITE	RC07GF472J
R176	000821	RES	CARBON	820 OHM	5%	1/4 W	OHMITE	RC07GF821J
R177	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R178	000472	RES	CARBON	4.7 K	5%	1/4 W	OHMITE	RC07GF472J
R179	000301	RES	CARBON	300 OHM	5%	1/4 W	OHMITE	RC07GF301J
R18	000132	RES	CARBON	1.3 K	5%	1/4 W	OHMITE	RC07GF132J
R180	000472	RES	CARBON	4.7 K	5%	1/4 W	OHMITE	RC07GF472J
R181	000202	RES	CARBON	2 K	5%	1/4 W	OHMITE	RC07GF202J
R182	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R183	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R184	000203	RES	CARBON	20 K	5%	1/4 W	OHMITE	RC07GF203J
R19	000153	RES	CARBON	15 K	5%	1/4 W	OHMITE	RC07GF153J
R191	000201	RES	CARBON	200 OHM	5%	1/4 W	OHMITE	RC07GF201J
R192	000201	RES	CARBON	200 OHM	5%	1/4 W	OHMITE	RC07GF201J
R193	000201	RES	CARBON	200 OHM	5%	1/4 W	OHMITE	RC07GF201J
R194	000201	RES	CARBON	200 OHM	5%	1/4 W	OHMITE	RC07GF201J
R195	000201	RES	CARBON	200 OHM	5%	1/4	OHMITE	RC07GF201J
R196	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102
R197	000201	RES	CARBON	200 OHM	5%	1/4 W	OHMITE	RC07GF201J
R198	000201	RES	CARBON	200 OHM	5%	1/4 W	OHMITE	RC07GF201J
R199	000201	RES	CARBON	200 OHM	5%	1/4 W	OHMITE	RC07GF201J
R20	000202	RES	CARBON	2 K	5%	1/4 W	OHMITE	RC07GF202J
R200	000302	RES	CARBON	3 K	5%	1/4 W	OHMITE	RC07GF302J
R201	000302	RES	CARBON	3 K	5%	1/4 W	OHMITE	RC07GF302J
R203	000302	RES	CARBON	3 K	5%	1/4 W	OHMITE	RC07GF302J

PARTS LIST

ASSEMBLY 403462 - 4700A

A

REF. DESIG.	PART NO.	DESCRIPTION							
R204	000431	RES	CARBON	430	OHM	5%	1/4 W	OHMITE	RC07GF431J
R205	000431	RES	CARBON	430	OHM	5%	1/4 W	OHMITE	RC07GF431J
R206	000431	RES	CARBON	430	OHM	5%	1/4 W	OHMITE	RC07GF431J
R207	000243	RES	CARBON	24	K	5%	1/4 W	OHMITE	RC07GF243J
R208	000203	RES	CARBON	20	K	5%	1/4 W	OHMITE	RC07GF203J
R209	000243	RES	CARBON	24	K	5%	1/4 W	OHMITE	RC07GF243J
R21	000202	RES	CARBON	2	K	5%	1/4 W	OHMITE	RC07GF202J
R210	000203	RES	CARBON	20	K	5%	1/4 W	OHMITE	RC07GF203J
R211	000243	RES	CARBON	24	K	5%	1/4 W	OHMITE	RC07GF243J
R212	000203	RES	CARBON	20	K	5%	1/4 W	OHMITE	RC07GF203J
R213	000202	RES	CARBON	2	K	5%	1/4 W	OHMITE	RC07GF202J
R214	000102	RES	CARBON	1	K	5%	1/4 W	OHMITE	RC07GF102J
R215	000122	RES	CARBON	1.2	K	5%	1/4 W	OHMITE	RC07GF122J
R216	020576	RES	WW	.24	OHM	5%	2 W		
R217	000511	RES	CARBON	510	OHM	5%	1/4 W	OHMITE	RC07GF511J
R218	000102	RES	CARBON	1	K	5%	1/4 W	OHMITE	RC07GF102J
R219	000512	RES	CARBON	5.1	K	5%	1/4 W	OHMITE	RC07GF512J
R22	040216	POT						CTS	X201
R220	000512	RES	CARBON	5.1	K	5%	1/4 W	OHMITE	RC07GF512J
R221	000512	RES	CARBON	5.1	K	5%	1/4 W	OHMITE	RC07GF512J
R222	000512	RES	CARBON	5.1	K	5%	1/4 W	OHMITE	RC07GF512J
R223	000512	RES	CARBON	5.1	K	5%	1/4 W	OHMITE	RC07GF512J
R224	000512	RES	CARBON	5.1	K	5%	1/4 W	OHMITE	RC07GF512J
R225	000102	RES	CARBON	1	K	5%	1/4 W	OHMITE	RC07GF102J
R226	000101	RES	CARBON	100	OHM	5%	1/4 W	OHMITE	RC07GF101J
R227	000102	RES	CARBON	1	K	5%	1/4 W	OHMITE	RC07GF102J
R228	000202	RES	CARBON	2	K	5%	1/4 W	OHMITE	RC07GF202J
R229	000202	RES	CARBON	2	K	5%	1/4 W	OHMITE	RC07GF202J
R23	040112	RES	VARI	2	K			BECKMAN	79PR2K
R230	000202	RES	CARBON	2	K	5%	1/4 W	OHMITE	RC07GF202J
R231	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R233	000106	RES	CARBON	10	M	5%	1/4 W1	OHMITE	RC07GF106J
R234	000104	RES	CARBON	100	K	5%	1/4 W	OHMITE	RC07GF104J
R24	000823	RES	CARBON	82	K	5%	1/4 W	OHMITE	RC07GF823J
R25	000205	RES	CARBON	2	MEG	5%	1/4 W	OHMITE	RC07GF205J
R26	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R27	403463	ASSY						DANA	403463

PARTS LIST

ASSEMBLY 403462 - 4700A

REF. DESIG.	PART NO.	DESCRIPTION							
R28	040026	RES	VARI	100 OHM				SPECTROL	51-3-11-101
R29	010614	RES			9 K	.02%		VISHAY	V53-1
R30	010613	RES			1 K	.02%		VISHAY	V53-1
R31	000622	RES	CARBON	6.2 K		5%	1/4 W	OHMITE	RC07GF622J
R32	403463	ASSY						DANA	403463
R33	040026	RES	VARI	100 OHM				SPECTROL	51-3-11-101
R34	000622	RES	CARBON	6.2 K		5%	1/4 W	OHMITE	RC07GF622J
R35	010685	RES	METAL FILM	909 OHM		1%		IRC	RN55E
R36	000242	RES	CARBON	2.4 K		5%	1/4 W	OHMITE	RC07GF242J
R37	000203	RES	CARBON	20 K		5%	1/4 W	OHMITE	RC07GF203J
R38	000202	RES	CARBON	2 K		5%	1/4 W	OHMITE	RC07GF202J
R39	010735	RES	METAL FILM	900 OHM		.01%		IRC	RN55C
R40	010692	RES		900 OHM		.01%		VISHAY	V53-1
R42	010691	RES		100 OHM		.01%		VISHAY	V53-1
R43	000515	RES	CARBON	5.1 M		5%	1/4 W	OHMITE	RC07GF515J
R44	040218	POT		25 K				CTS	X201
R45	000513	RES	CARBON	51 K		5%	1/4 W	OHMITE	RC07GF513J
R46	000513	RES	CARBON	51 K		5%	1/4 W	OHMITE	RC07GF513J
R47	000102	RES	CARBON	1 K		5%	1/4 W	OHMITE	RC07GF102J
R48	000243	RES	CARBON	24 K		5%	1/4 W	OHMITE	RC07GF243J
R49	000332	RES	CARBON	3.3 K		5%	1/4 W	OHMITE	RC07GF332J
R50	000332	RES	CARBON	3.3 K		5%	1/4 W	OHMITE	RC07GF332J
R51	000243	RES	CARBON	24 K		5%	1/4 W	OHMITE	RC07GF243J
R52	000102	RES	CARBON	1 K		5%	1/4 W	OHMITE	RC07GF102J
R53	000203	RES	CARBON	20 K		5%	1/4 W	OHMITE	RC07GF203J
R54	000822	RES	CARBON	8.2 K		5%	1/4 W	OHMITE	RC07GF822J
R55	000203	RES	CARBON	20 K		5%	1/4 W	OHMITE	RC07GF203J
R56	000102	RES	CARBON	1 K		5%	1/4 W	OHMITE	RC07GF102J
R57	000103	RES	CARBON	10 K		5%	1/4 W	OHMITE	RC07GF103J
R58	000512	RES	CARBON	5.1 K		5%	1/4 W	OHMITE	RC07GF512J
R59	010690	RES		4 K		.1%		VISHAY	V53-1
R60	040183	POT		10 OHM				BECKMAN	62PR10
R61	010690	RES		4 K		.1%		VISHAY	V53-1
R62	040217	POT		10 K				CTS	X201
R63	000513	RES	CARBON	51 K		5%	1/4 W	OHMITE	RC07GF513J

PARTS LIST

ASSEMBLY 403462 - 4700A

A

REF. DESIG.	PART NO.	DESCRIPTION							
R64	000302	RES	CARBON	3	K	5%	1/4 W	OHMITE	RC07GF302J
R65	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R66	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R67	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R68	000208	RES	CARBON	2000	MEG	20%	1/4 W	AB	CB2082
R69	000114	RES	CARBON	110	K	5%	1/4 W	OHMITE	RC07GF114J
R70	000823	RES	CARBON	82	K	5%	1/4 W	OHMITE	RC07GF823J
R71	040219	POT		250	K			CTS	X201
R72	000244	RES	CARBON	240	K	5%	1/4 W	OHMITE	RC07GF244J
R73	000752	RES	CARBON	7.5	K	5%	1/4 W	OHMITE	RC07GF752J
R74	000202	RES	CARBON	2	K	5%	1/4 W	OHMITE	RC07GF202J
R75	000102	RES	CARBON	1	K	5%	1/4 W	OHMITE	RC07GF102J
R76	000104	RES	CARBON	100	K	5%	1/4 W	OHMITE	RC07GF104J
R77	000105	RES	CARBON	1	M	5%	1/4 W	OHMITE	RC07GF105J
R78	000243	RES	CARBON	24	K	5%	1/4 W	OHMITE	RC07GF243J
R79	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R80	000243	RES	CARBON	24	K	5%	1/4 W	OHMITE	RC07GF243J
R81	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R82	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R83	000512	RES	CARBON	5.1	K	5%	1/4 W	OHMITE	RC07GF512J
R84	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R85	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R86	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R87	000203	RES	CARBON	20	K	5%	1/4 W	OHMITE	RC07GF203J
R88	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J
R89	010338	RES	METAL	1	MEG	1%	1 W	PYROFILM	PME75
R90	010689	RES		1	MEG	.1%		IRC	RN65E
R91	010688	RES		54.9	K	.1%		IRC	RN55E
R92	040198	POT		1	K			CTS	U201
R93	010687	RES		4.99	K	.1%		IRC	RN55E
R94	040200	POT		100	OHM	30%		CTS	U201
R95	010684	RES	METAL FILM	487	OHM	1%		IRC	RN55E
R96	040098	RES	VARI	20	K	10%		BECKMAN	62PR20K
R97	000201	RES	CARBON	200	OHM	5%	1/4 W	OHMITE	RC07GF201J
R98	000103	RES	CARBON	10	K	5%	1/4 W	OHMITE	RC07GF103J

PARTS LIST

ASSEMBLY 403462 - 4700A

A

REF. DESIG.	PART NO.	DESCRIPTION						
R99	000562	RES	CARBON	5.6 K	5%	1/4 w	OHMITE	RC07GF562J

MIXIE

Appendix ZM1005

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